Initial Environmental Examination

April 2014

NEP: South Asia Subregional Economic Cooperation Power System Expansion Project
- Transmission and Distribution

Prepared by Nepal Electricity Authority for the Asian Development Bank. This is an updated version of the draft originally posted in February 2014 available on http://www.adb.org/projects/documents/sasec-power-system-expansion-project-rereap-component-iee

Asian Development Bank
Nepal: South Asia Subregional Economic Cooperation (SASEC)
Power System Expansion Project (SPEP) On-grid Components

INITIAL ENVIRONMENTAL EXAMINATION

Revised Draft – April 2014

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Abbreviations and Units

ACA	Annapurna Conservation Area
ADB	Asian Development Bank
CARE	Cooperative for Assistance and Relief Everywhere
CBS	Central Bureau of Statistics
CFUG	Community Forest Users Group
CHAL	Chitwan Annapurna Landscape
CITES	Convention on International Trade in Endangered Species
DDC	District Development Committee
EA	Executing Agency
EBA	Endemic Bird Area
EIA	Environmental Impact Assessment
EMP	Environmental Management Program
EPA	Environmental Protection Act
EPR	Environmental Protection Regulations
ESSD	Environmental and Social Studies Department of NEA
FAO	Food and Agriculture Organisation
FECOFUN	Federation of Community Forestry Users in Nepal
FRP	Fire Radiative Power
Gal	$0.01 m/s^2$
GLOF	Glacier Lake Outburst Flood
GON	Government of Nepal
GRM	Grievance redress mechanism
GWh	Giga-watt hour (a measure of energy output)
IBA	Important Bird Area
ICIMOD	International Centre for Integrated Mountain Development
IEE	Initial Environmental Examination
IUCN	International Union for Conservation of Nature
km	Kilometer
kV	Kilovolt
LDOF	Landslide Dam Outburst Flood
m	Meter
MODIS	Moderate Resolution Imaging Spectroradiometer
MW	Megawatt (a measure of power capacity)
NASA	National Aeronautics and Space Administration
NEA	Nepal Electricity Authority
NTNC	National Trust for Nature Conservation

PCB	Poly-chlorinated biphenyls
PIU	Project Implementation Unit
REDD	Reducing Emissions from Deforestation and Forest Degradation
ROW	Right-of-way
TAL	Terai Arc Landscape
TCL	Tiger Conservation Landscape
tCO_2e	tons carbon dioxide equivalent
USAID	United States Agency for International Development
VDC	Village Development Committee
WPD	Wind Power Density
WWF	World Wide Fund for Nature

1. EXECUTIVE SUMMARY

1.1 Introduction

The proposed South Asia Subregional Economic Cooperation (SASEC) Power System Expansion Project (SPEP, the Project) is included in the Asian Development Bank (ADB) Country Partnership Strategy 2010-2012 for Nepal, and the Country Operations Business Plan 2013-2015. The Project targets the strengthening and expansion of transmission and distribution systems that will enable Nepal to further benefit from power trading and development of its abundant hydropower resources. Transmission network strengthening and expansion, in conjunction with current hydropower generation development, is a precondition to reducing load shedding and increased cross border electricity trade.

Project Outputs. The project includes 4 outputs:

(i) Output 1. Power transmission capacity increase comprising: (a) construction and augmentation of 45 kilometers (km) of 400 kilovolt (kV) and 191.5 km of 220 kV transmission lines along Kali Gandaki corridor; (b) construction or augmentation of 500 megavolt-ampere (MVA) of 400 kV/220 kV/132 kV, 500 MVA of 220 kV/132 kV/33 kV, and 120 MVA of 33 kV/11 kV grid substations along Kali Gandaki corridor and Marsyangdi-Kathmandu route; and (c) construction or replacement of grid service substations with an aggregated capacity of 393.8 MVA across the country.[1]

(ii) Output 2. Power distribution network improvements comprising the construction and upgrading of 410 km of 33 kV, 545 km of 11 kV, and 725 km of 400 V distribution lines, and distribution substations of 216 MVA in East, Central and West regions.

(iii) Output 3. Mini-grid based renewable energy (RE) systems in off-grid areas increased. This includes installation of up to 4.3 MW of aggregated mini hydro-electric power plants and up to 0.5 MW of aggregated mini-grid based solar or solar/wind hybrid systems, in selected rural communities, through the provision of (a) a credit line of $5 million from ADB's Special Funds to user communities for mini-hydro power plants and (b) a $10 million grant from the Strategic Climate Fund (SCF) [2] administered by ADB. [3]

(iv) Output 4. Capacity development support to the Nepal Electricity Authority (NEA) and the Alternative Energy Promotion Center (AEPC). The physical investments will be reinforced and supplemented by capacity building support to NEA and AEPC, including project management support, preparation of distribution system/rural electrification master plan and feasibility study of utility level wind farm, and parallel livelihood development activities in the project area.

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[1] EIB is considering cofinancing the construction of 125 km of 220 kV transmission line and 400 MVA of 220 kV/132 kV/33 kV substations in the Marsyangdi corridor, and 24 km of 132 kV transmission line, and 30 MVA 132 kV/33 kV and 6/8 MVA of 33 kV/11 kV substations at Samundratar-Trishuli 3B transmission hub.

[2] SCF is a multi-donor trust fund under the Climate Investment Funds, administered by ADB.

[3] Outputs 3 and 4 will be implemented as integral parts of the National Rural Renewable Energy program (NRREP).

Project implementation services will be provided, including support for design, bid specifications, procurement, environmental and social safeguards implementation, and livelihood improvement in the transmission corridors. The detailed project description is presented in Section 3.

This draft Initial Environmental Examination (IEE) was prepared on behalf of the Nepal Electricity Authority (NEA), the Executing Agency (EA) for the Project, by consultants retained under ADB TA-8272. Under the Nepal environmental regulatory framework, the proposed transmission lines require an Initial Environmental Examination (IEE) except for lines in protected areas which require an EIA. This report content and format are consistent with ADB *Safeguard Policy Statement 2009* (SPS 2009). This report covers the on-grid project components. The off-grid RE based mini-grids component was developed under a separate project preparatory technical assistance; the IEE for the off-grid component is presented as a companion report.

1.2 Summary Findings of Environmental Assessment

Field Survey and environmental assessment have been carried out on the Kali Gandaki, Marsyangdi, and Samundratar-Trishuli transmission corridors in accordance with *ADB Safeguard Policy Statement 2009*. The assessment has been based on routing information provided by the Nepal Electricity Authority's (NEA) survey/reconnaissance reports and field visits. At present NEA has conducted or will be conducting IEEs and/or EIAs for individual transmission lines as required by Nepali regulations. Immediate environmental effects expected in most of these project sites are short-term and reversible, being limited to excavation work for tower footings, acquisition of land for substation, and clearing of vegetated areas within right of way (ROW). Mitigation actions include reconditioning excavated land and re-planting of trees at a ratio of 1:25 or compensation to agro forest trees. Discussion of the most significant issues for each major transmission line follows.

Kaligandaki Corridor 220 kV

The Kaligandaki Corridor runs from the proposed Dana Substation in Myagdi District to Bardhaghat of Rupandehi District via Kushma and New Butwal Substation. A 2.4 km section of this line will be in the Annapurna Conservation Area (ACA); the ACA is an IUCN Management category VI area, the lowest level of protection, which allows multiple land uses including electric power infrastructure. Most of the line will cross cultivated lands in the Chitwan Annapurna Landscape, the Terai Arc Landscape, the Tiger Conservation landscape and the so-called Dovan Bottleneck, which overlap in part as shown below in Figure 1; these are not legally protected areas and are not considered to be critical or natural habitat due to extensive human alteration. A 15.8 km section of the transmission line will cross the Dovan bottleneck and Tiger Conservation Landscape. No documentation of tigers has been recorded in a study[4] done in the areas through which the transmission line crosses. However, a contribution to reforestation in these areas can positively benefit in establishing a corridor for extension of tiger habitat[5].

[4] Karki, J. B. (2009). *Tiger and Their Base Prey Abundance in Terai Arc Landscape Nepal,* downloaded on November 28, 2010 from http://www.dnpwc.gov.np/publication.asp. Kathmandu: Department of Natonal Park and Wildlife Conservation, MoFSC, Department of Forest and WWF Nepal Program.

[5] Wikramanayake, E., McKnight, M., Dinerstein, E., Joshi, A., Gurung, B., & Smith, D. (2004, June). Designing a Conservation Landscape for Tigers in Human-Dominated Environments. *Conservation Biology, 18*(3), 839-844.

This transmission line crosses close to some important bird areas, including in the ACA, the Nawalparasi Forest, and Farmlands of Lumbini, wherein some migratory birds have been observed. Adding marking devices to transmission lines close to such areas will reduce potential for bird collision. The 2.4 km section of the line in the ACA will have a 7.2 ha footprint (assuming 30 m RoW) of which 1.3 ha is cultivated land, 3.4 ha is forest land, and 2.5 ha is barren or bushy areas; this section is at altitudes between 1200 to 1250 meters above sea level (masl) which is outside the elevation range of potentially sensitive flora and fauna. As this section of transmission line is close to the western boundary, routing outside the protected areas may be possible. The area traversed in the ACA does not include dense forest. The ACA is a popular trekking destination, and transmission lines in these areas may reduce the aesthetic value of the area, which is the primary factor that attracts tourists. Therefore avoiding areas close to these trekking routes by selecting sites beyond visible range would minimize any negative impact to tourism.

The Kaligandaki Basin has 96 glacial lakes of which four have been considered to be potentially dangerous; of these 4, one is 119 km upstream from the proposed Dana Substation site and the other is 105.3 km upstream. Reasonable consideration needs to be made at construction activities close to the river banks. In areas close to New Butwal the towers need to avoid sites with potential of river undercutting.

The benefits will outweigh the impacts by:

(i) Reducing peak load stress in national grid which will result in reduced emission from fossil fuel, mainly from reduced use of back-up and standby generator sets fired with diesel or gasoline/petrol.
(ii) Improve living standard of people living in Project Area through sharing the benefits.
(iii) Improve living standard of people living in the ACA through sharing the benefits and also aid in Conservation Activities of ACAP; projects in protected areas are required to share 10% of their royalty to the Management Authority which will be used in its conservation and management activities. ACA has a Conservation Area Management Committee with active participation by local communities which benefits local people in decision making process.

Marsyangdi Corridor 220 kV

The Corridor is routed adjacent to the Marsyangdi River for most of its length. The proposed 25 km Manang-Khudi transmission section and the Khudi and Manang substations are located within the intensive use zone of the ACA (see Figure 2). Based on desk studies, NEA Survey Report, and field visits, no dense forest areas have been identified to be traversed by the proposed routing within the ACA. The total footprint of the transmission line is less than 0.02% of the total area of the ACA (see Table 2). Of the total line, 27% of the route crosses through vegetated areas, and the rest is cultivated land or settlement areas. Similar to the Kaligandaki Corridor, the impacts in this corridor will occur due to clearing vegetated areas, and are generally short-term and reversible.

Mapping of sensitive species in the protected areas shows that Musk Deer, Red Panda and Snow Leopard are found at elevations higher than the proposed line routing. However, common leopard may be present in some forested areas around the ROW. Approximately 8 to 9 km of the transmission line between Manang and Khudi is between 1500 to 2500 masl which is within the altitudinal range of the clouded leopard; 2.7km of the line in this elevation range is forested.

Approximately 40 km upstream from the proposed Khudi Substation Site is the potentially dangerous Thulagi glacial lake. This lake contributes to a tributary of the Marsyangdi River that joins at Dharapani. Based on modeling studies, outburst flood could impact areas downstream: at 50 km downstream a surge of up 18 m could be experienced, and at 95 km downstream a surge of up to 4 m is predicted. Hence, line located in proximity to the river should have tower footings located above these potential flood levels.

Markichowk-Kathmandu 220 kV
Adjacent to the Marsyangdi corridor is the 81.54 km Markichowk-Kathmandu 220 kV line, which will pass through 17 VDC's of Tanahu, Chitwan, Kathmandu, Gorkha and Dhading Districts. A total of 109.92 ha of forest.and 162.53 ha of cultivated land will be affected.

The benefits will outweigh the impacts by:

(i) Reducing peak load stress in national grid which will result in reduced emission from fossil fuel.
(ii) Improve living standard of people living in Conservation Area through sharing the benefits and also aid in Conservation Activities of ACAP. Since projects in pretected areas are required to share 10% of their royalty to Park Management Authority which will be used in its conservation and management activities. Since ACA has Conservation Area Management Committee actively participated by local communities it will benefit local people in decision making process too.
(iii) Reducing threats to wildlife by causing improved living standard of local people and hence easing the level of livelihood-wildlife habitat overlap in spite of the transmission line causing potential habitat fragmentation. Several publications on poverty and biodiversity conservation have found that people living in biodiversity hotspots are often the poorest, because of low population densities and isolation from economic infrastructure. As a result, dependence on natural resources is high and daily human activities overlap with wildlife habitat. A study[6] on migration trends in Nepal documented recent internal migration in these areas towards urban centers, particularly to Pokhara; improved living standards can trigger migration of the poorest to urban areas thus reducing direct and immediate pressure on sensitive ecosystems. Another report on snow leopard trafficking in Asia supports these findings, noting that poverty is a key factor in illegal wildlife killings. Conflicts arise when such carnivores can attack easy prey (e.g., livestock) because they are not kept in well-guarded or predator proof corrals. Therefore improving living standard and contribution to such activities will also reduce human wildlife conflict in protected or sensitive areas. The transmission lines directly or indirectly will help in reducing poverty and hence should contribute to biodiversity conservation.

Samundratar - Trishuli 132kV
The Samundratar Trishuli 132kV is located south of the Buffer Zone of the Langtang National Park. The 3B Transmission Hub is located at Archale of Manakamna VDC of Nuwakot District on the right bank of Trishuli River; the left bank of the river falls is partly in the buffer zone of Langtang National Park.

[6] Subedi, B. P. (1988, June-December). Continuity And Change In Population Movement: The Case Of Nepal. *Population Geography, 10*(1 and 2), 28-41.

Approximately 1.8 km of the 132kV line is tentatively routed through Chir Pine Forest with 70% crown cover. Locals have noted the presence of leopards, pheasants, monkeys among other wildlife in the area. Rerouting to avoid this section is recommended.

Other Key Observations and Findings

The proposed Project comprises clearing of right-of-way, construction of new high-voltage transmission lines, construction of new substations, and augmentation of existing transmission substations. Potential impacts during construction will arise from clearing of vegetation, equipment staging, construction of substations, erection of transmission towers, stringing of conductors on the towers, and temporary construction camps. The anticipated impacts are localized, minimal, temporary, and reversible. Any loss of trees and other vegetation will be directly offset by reforestation and indirectly offset by reduction in fossil fuel powered generator sets. The proposed Project is the best alternative with respect to economic, environmental, financial, and social criteria.

Potential negative environmental impacts can be mitigated by implementation of the environmental management program (EMP). The EMP cost estimates and work program comprise routine baseline and periodic monitoring, and support for reforestation. The IEE and EMP will be updated and revised as necessary to ensure that environmental and ecological objectives in the project area are met (as discussed in Section 7).

The environmental assessment to date complies with ADB and Nepali policy and guidance for energy sector projects. This IEE is a dynamic document: assurances will be incorporated into loan and project agreements to ensure that the IEE and EMP are updated as necessary and are fully implemented.

Under the Nepal environmental regulatory framework, the NEA will obtain survey and transmission licenses for individual transmission lines rather than for the entire Project, and each proposed transmission line requires an IEE, or an EIA for lines in protected areas. The Project includes a 25 kilometer (km) transmission line from Manang to Khudi, with substations at either end, which all lie within the Annapurna Conservation Area (ACA); an EIA will be required for this transmission line and substations. The Manang-Khudi line and substations are not scheduled to go into service until 2019, with construction expected to commence in 2 years prior to operations; thus, there are more than 2 years to complete the EIA prior to construction. For other transmission lines, the earliest construction activities are expected to begin in 2015, allowing about 1 year to complete IEEs. Thus, this report serves as input to the IEEs and EIA for the individual transmission lines to completed going forward.

1.3 Report Organization

The IEE is presented in 3 volumes. Volume 1 includes:

- Section 2 describes the policy, legal, and administrative framework for the project including the environmental assessment process.
- Section 3 describes the need for the project, proposed design, analysis of alternatives, and expected benefits.
- Section 4 provides a description of the environment for the overall project.

Volume 2 covers the following sections for the transmission outputs:

- Section 5 discusses potential environmental impacts, benefits, and mitigation measures.
- Section 6 describes public participation and consultation activities, information disclosure, and grievance redress mechanism.
- Section 7 presents the Environmental Management Plan (EMP).
- Section 8 presents conclusions and recommendations.
- Appendix 1 lists important flora and fauna along areas in or close to the project site with rich biodiversity. Appendix 2 presents habitat maps of important species. Appendix 3 summarizes various activities which may indirectly offset environmental impacts caused by the Project. Appendix 4 presents detailed routing maps for one transmission segment in the Annapurna Conservation Area (ACA) plus selected photographs of the project areas.

Volume 3 is under preparation and includes the following sections for the distribution outputs:

- Section 5 discusses potential environmental impacts, benefits, and mitigation measures.
- Section 6 describes public participation and consultation activities, information disclosure, and grievance redress mechanism.
- Section 7 presents the Environmental Management Plan (EMP).
- Section 8 presents conclusions and recommendations.
- Additional appendices

2. Policy, Legal, and Administrative Framework

Nepal integrated environment aspects in all its development activities and projects only from early 1980s. Environment conservation was included in the policies since the Fifth Plan (1975-1980). 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 developmental programs would be implemented only after an approved EIA/ IEE report. The plan outlined the need for carrying out EIA/IEE processes for industrial, tourism, transportation, water resources, urbanization, agriculture, forests and other development programs 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/IEE system and inclusion of mitigation cost into the total project cost were some of the activities included in these three five year plans. The major policies, acts and regulations and guidelines related to the project are discussed below.

The prevailing Acts, Policies, Regulations and Guidelines, which are required for the construction and operation of Transmission Line Projects in Nepal, have been reviewed while preparing the present IEE report and some of the important guidelines and acts and their relevancy in transmission line and hydropower development have been discussed below:

2.1 Plans and Policies

i. Nepal Environmental Policy and Action Plan, 2050 (1993) and 2055 (1998)

Nepal Environmental Policy and Action Plan (NEPAP) were endorsed to further institutionalize environmental protection in the development processes. NEPAP recognize that a growing number of people are exposed to pollute from industrial enterprises. NEPAP identifies the following factors as contributing to this process:

- Industrial plan inappropriately cited close to population centers
- Insufficient emphasis on fuel efficiency.
- Little, if any pollution abatement equipment used for reducing emission, and
- A total lack of industry pollution standards.

Hence, the NEPAP emphasized the need for mitigating adverse environmental impacts to address urban and industrial development, air and water pollution and infrastructures development.

ii. Forestry Sector Policy

The Forest Sector Policy of Nepal such as the National Forestry Plan, 1976, Master Plan for the Forestry Sector, 1988, Periodic Five Year Plan and Forestry Sector Policy, 2000 have emphasized for people participation in the forestry management. Nepal's main forest management is based on people's participation and various management models are underway. Similarly, Forestry Sector Policy, 2000 stresses on conservation of biodiversity, ecosystem and protection of land degradation by soil erosion, landslide, floods desertification and other ecological disturbances. The Public participation in forest management is sought through community forestry, collaborative forest management, leasehold forestry etc. The mitigation measures such as plantation, NTFP program and other social and community support program proposed by the project will implemented by mobilizing the local people which is in line with the Forest Sector Policy.

The procedural guidelines for the use of forest land for other purpose stated that feasibility study will be carried out with no use of forest land to the extent possible. If it is not possible, the alternate will be considered with minimum use of forest land. This guideline also stated that the project proponent will be responsible for the plantation of 25 tree species for the loss of one tree and their management for 5 years and handing over to the concerned forest office of the district.

iii. Hydropower Development Policy, 2058 (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 fuel wood and to render necessary assistance in the conservation of forest and environment.

iv. Policy for Construction and Operation of Physical Infrastructure within Conservation Area, 2065 (2008)

The policy describes the terms and conditions required for implementing projects inside protected areas. Implementation of mitigation measures, allocation of royalty for conservation activities, payment for use of natural resources and monitoring are some of the conditions mentioned in the policy.

v. National Wetlands Policy of Nepal 2059 and 2069 (2003 and 2012)

National Wetlands Policy defines wetlands as perennial water bodies that originate from underground sources of water or rains. It means swampy areas with flowing or stagnant fresh or salt water that are natural or man-made, or permanent or temporary. Wetlands also mean marshy lands, riverine floodplains, lakes, ponds, water storage areas and agricultural lands. The Nepali term for wetland is Simsar and the new National Wetland Policy accepted in 2069 BS (2012) mentions the need for conservation, restoration and effective management of wetlands. In addition to this its objectives explain wise utilization of wetland resources and support for community dependent on such wetlands. It also makes clear that development activities should not lead to reduced quality and area of wetland. The policy mentions 750,000 ha (5%) of Nepal's land consists of wetlands.

Power and Water Sector Acts and Regulations

The current provisions for the environmental review of power and water sector projects as set out in the Acts and Regulations are described as follows:

2.2 Acts

vi. Environment Protection Act, 2053 (1997)

Nepal has enacted a comprehensive and umbrella type Act, the Environment Protection Act, 1998 (EPA, 97) which is now enforced through appropriate regulatory measures. The EPA provides a legal basis for the concerned authorities for regulation an initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA). Section 3 of the Act requires the proponent to conduct an IEE or EIA in relation to the prescribed proposals. The Act uses the word proposal instead of Projects which makes the scope of the Act much broader in relation to environmental studies. Proponent includes any government, semi government or non-government agency or organization submitting an application for the approval of a proposal and possessing the responsibility to work according to such a proposal or implementing the proposal. According to the provision in section 6 (1) of the Act, the relevant agency is empowered to grant approval for the IEE and EIA report, only if it finds that no significant adverse effects will be caused to the environment by the implementation of the proposal. Implementation of any proposal

without the approval of the relevant agency is prohibited by the Act.

vii. Water Resources Act, 2049 (1992)
The objectives of the Water Resources Act, 2049 is to make legal arrangements for determining beneficial uses of water resources, preventing environmental and other hazardous effects thereof 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 IEE report 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 a water resource.

viii. Electricity Act, 2049 (1992)
Electricity Act, 2049 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 survey, generation, transmission or distribution of electricity without obtaining a license is prohibited. The Electricity Act, 2049 also contain provisions to minimize soil erosion, flood, air pollution and damage on environment while producing electricity and transmission of the power (Article 24). The Electricity Rule, 2050 emphasize environmental analysis, which should include environmental mitigation measures to minimize adverse impacts likely to occur while developing hydro-electricity (Rule 12 and 13).

ix. Land Reform Act, 2021 (1964)
The Land Reform Act, 1964 is considered as a revolutionary step towards changing the existing system of land tenure by establishing rights of tenants and providing ownership rights to actual Tiller. To date it has been amended five times. Article sets ceiling on land ownership according to geographical zones. Article 25(1) of this act deals with tenancy rights that also exists.

x. Land Acquisition Act, 2034 (1977)
One of the important acts that have a bearing on the implementation mechanisms and mitigation 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.

xi. Forest Act, 2049 (1993)
The Forest Act, 2049 (amendment 2055) recognizes 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 account of all forest values, including environmental services and bio-diversity. It emphasizes the development and implementation of an approved work plan for different categories of forest, i.e. community forests, leasehold forests, private forests and religious forests.

xii. Child Labor Act, 2049 (1991)
This act is enforced by GoN in 2049/2/2. This act classified below 15 years as child and 'anabolic' for the age group of above 14 years and below 18 years. The act has also made provision of labour court and department of labour. The act clearly mentioned 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 the time bond contract for the manpower required for development work. The act specifies that working hours for the Anabolic and women must be within 6 AM to 6 PM which clearly restrict to deploy women in night works. The act also stated that equal opportunity shall be given to women as 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.

xiii. Soil and Watershed conservation Act, 2039 (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.

xiv. Aquatic Animals Protection Act, 1961
This Act provided legislative protection of the habitats of aquatic species. Under this Act, it is offence to introduce poisonous, noxious or explosive material in to a water source or destroy any dam, bridge, fish ladder or water system with the intent of catching or killing aquatic life. The Act was amended in 1988 to prohibit the use of unsafe pesticides.

xv. Local Self-Governance Act, 2055 (1998)
The Local Self-Governance Act, 2055 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 the 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.

2.3 Rules and Regulations

xvi. Conservation Area Management Rule 2053 (1996)
Conservation Area Management Rule in Rule 16 under sub rule 1 and 2 directs prohibited activities inside Conservation Area. These activities include hunting, removal of plant materials, excavation, and using helicopters for transportation. Any activities within its premises need to strictly follow through written permission or approval of the Chief of the protected area with such activity giving priority to local consumers as mentioned in Rule 21 in Sub rule 1, 2 and 3. Rule 23 prescribes conditions on the privilege of using transit in road of the protected area.

Nepali regulations allow flexibility with respect to development in conservation areas. Chapter 5, paragraph 16, of the *Conservation Area Management Rules* published on 2

December 1996 (pursuant to Section 33 of *National Parks and Wildlife Conservation Act* of 1973), prohibits hunting, removal of trees and other vegetation, mining, use of explosives, etc., without written permission of the chief. These rules note further that a license for commercial activities shall be taken from the chief, that any commercial activities must be consistent with the conservation area management plan(s). Large-scale infrastructure is allowed if environmental assessments are conducted and approved prior to securing the necessary license(s).

In the case of electric power infrastructure, the *Conservation Area Management Rules* have been interpreted to allow for large scale hydropower and associated grid expansions, e.g., as is the case with the 456 MW Upper Tamakoshi hydropower project in the Gaurishanker Conservation Area in eastern Nepal, and in the case of the ACA which is host to well over 1000 MW of proposed hydropower capacity. The ACA management plan notes 6 key outcomes which include conservation of key flora and fauna, improvements in livelihoods, and ecotourism benefitting the local population (especially the poor and disadvantaged groups). In this context, provision of energy services from run of river hydropower and other renewable energy resources (e.g., solar and wind) are clearly preferable to continued reliance on traditional biomass which contributes to deforestation and habitat loss. Section 2.7 of the *Management Plan of the ACA 2009-2012* (yet to be updated) specifically notes that micro-hydropower is allowed; the plan is otherwise not specific about large-scale infrastructure but as noted above the *Conservation Area Management Rules* have been interpreted to allow for large scale hydropower and associated grid expansions.

xvii. Environment Protection Rule, 2054 (1997)

The Environment Protection Rule (EPR) was endorsed in June 1997 and was made under the provisions of the Environment Protection Act. The EPR has been amended several times, with amendments noting the need to conduct IEE study for transmission line above the voltage level of 66 kV. An amendment in 2009 (2065/11/26) schedule-1, pertaining to rule 3 further states that if the implementation of transmission line with 220 kV or more requires clearance of more than 5 ha of forest, then EIA study is required. [There is some uncertainty about whether this criteria is routinely enforced, as GoN has also waived many EIA requirements due to the ongoing power shortages.] The EPR adopts the environmental assessment criteria mentioned in the EIA guidelines. The EPR establishes the administrative framework for assessing, exhibition and determination of the EIA/IEE, in terms of issues needing to be addressed and the format/layout of the EIA/IEE document.

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 up to Rs 50,000. If a proposal is implemented without the approval of the Ministry of Environment (in case of IEE, Ministry of Energy) or relevant government agency, or the person implementing the proposal is not complying with the conditions of the approval or license, the authorized official is empowered to close down that activity and may impose fine of up to Rs. 100,000 on such person or organization.

xviii. Forest Rule, 2052 (1992)

Rule 65 of Forest Riles stipulates that in case the execution of any project having national priority in any forest area causes any loss or harm to any local individual or community, the proponents of the project itself shall bear the amount of compensation to be paid. Similarly, the entire expenses required for cutting the transporting the forest products in a forest area to be used by the approved project should be borne by the proponents of the project.

xix. Electricity Regulation, 2050 (1993)
Regulations on electricity sectors have been formulated for the implementation of the provisions made in the Electricity Act, 2049. Rule 12 (f) and Rule(g) are related to the EIA/ IEE process which emphasize that the IEE 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.

xx. Water Resources Regulation, 2050 (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 detail information about the project to the people.

xxi. Local Self Governance Regulations, 2000
Local Self Governance Regulation empower the local bodies to coordinate and implement development program and for rationale utilization of local natural resources. Article -7 (69) empowers the VDCs for monitoring and supervision of development work implemented in the VDC. The Article - 4 of DDC has provision of 3 members (Agriculture, Forest and Environment) committee to look after the concerned issues. Article-6 (206) specifies that the need of social, economic, environmental and public facilities should be consider while planning the project. Article -7 (210) focuses on environmental studies and stresses due consideration while implementing the project like sand quarry, stone quarry and coal mines etc.

2.4 Guidelines and Conventions

xxii. National Environmental 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. The guideline was part of a comprehensive program to develop the national and sectoral guidelines for establishing a national system for Environmental Impact Assessment which was part of GoN's National Conservation Strategy. The EIA Guideline was endorsed by GoN on 27 September 1992 and gazette 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

xxiii. EIA Guidelines for Forestry Sector 1995
The GoN in keeping with the spirit of the National Environmental Impact Assessment Guidelines, 1993 framed EIA guidelines for the forestry sector in 1995. The Guideline aim to facilitate the sustainable use of forest resources for socio- economic development and meeting basic need to the community regarding the forest products, to

make proposals socio culturally acceptable, economically feasible, and environmental friendly to conserve genetic resources and biodiversity and minimize environmental damage in forest areas and facilitate in identification of positive and negative impacts of programs to be implemented by other agencies in forest areas. The guideline emphasized the need of carrying out an EIA /IEE study of development projects and programs proposed for implementation in forest areas.

xxiv. Forest, Production, Collection and sales Distribution Guidelines, 2057 (1998)
The guidelines clauses 3 to 10 have specified various procedure 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.

xxv. EIA Guidelines for Agriculture Sector, 2003
The guideline was developed to minimize impacts on the agriculture sector due to increase in agriculture products and productions and the activities of projects implemented by other organizations. The construction of the proposed project will require acquisition of agriculture land. Hence the provisions of the guideline are relevant to the proposed project.

xxvi. National Health Care and Waste Management Guideline, 2002
The guideline sets procedures for handling of health care waste which includes details of collection, separation and final disposal of the waste for the safety of human health and hygiene vis a vis environmental contamination

xxvii. 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 study. The purpose of an environmental study in relation to biodiversity conservation is to identify in advance:
• The aspects of the project which is likely to have significant adverse effects on biological diversity at genetic, species and ecosystem level, and
• The steps to be taken to avoid or minimize significant adverse effects to ensure that the proposed project comply with existing environmental legislation.
• The GoN under National Park and Wildlife Conservation Act 2029, (1973) has included 38 species of wild animals and the Forest Act 2049, (1993) has included 17 species of plants in the protection list. If the project area is in the core habitat of these species and project activity will likely to affect them, mitigation measures shall be proposed and be implemented to avoid and/ or mitigate the adverse impacts. Nepal is a party to the convention of Biological diversity and in accordance to the article 14, adequate attention should be given to minimize and or avoid the impacts.

xxviii. Convention in international Trade in Endangered Species of Wild Fauna & Flora (CITES)
Nepal became a contracting party to the convention on 18 June 1975.That aims to control the trade of certain wildlife species to prevent further endangered of their survival. CITES classified species according to the following criteria:

- Species threatened with extinction
- Species which could become endangered.
- Species that are protected

As Nepal is party to the convention related to species conservation, attention should be given to evaluate the impacts of the project activities on meeting their obligation. It is

relevant to IEE study that species protection list could also be used to evaluate the significant of the identified and predicted impacts. Plant and wild animal species under legal protection provides a basis to purpose EMPs for their conservation and for least damaging them during project implementation.

xxix. Community Forest Guidelines, 2058 (2001)

This guideline has been prepared by including amendments of acts, rules by officials of GoN and related experts. Through these guidelines persons involved in the development and management of community forest like facilitators, users groups, forester and managers etc will get help to understand about the process and stages of development of community forest. Forest users group, forest officials, NGOs and INGOs are getting benefit by this guideline. Till date, more than 15000 community forests have been handed over to the community forest users groups.

xxx. Community Forest Inventory Guidelines, 2005

The guideline for inventory of community forests advice to classify the forest into timber trees, pole size trees and regeneration on the basis of diameter. It has recommended using 20m x 20m size of quadrant for timber trees, 10m x10m for shrub and 5m x 5m for regeneration plots in the community forest. Plants having dbh (diameter at breast height, i.e. 1.3m above ground) greater than 30 cm is considered as trees. Trees having dbh between 10 and 29.9 cm are categorized as pole and plants having less than 10 cm dbh belong to regeneration species.

xxxi. International Labour Organization (ILO) Convention of Indigenous and Tribal Peoples (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 principle and approaches provided for under convention No. 169 and its adoption therefore provide a fresh impetus for promoting the ratification and implementation of 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 indigenous people. Article- 6 deals the consultation of the peoples concerned through appropriate procedure in particular through their representative institutions.

In Article 15, the rights of the people concerned to the natural resources pertaining to their lands shall cover the total environments of the areas which the peoples concerned occupy or other use. The peoples concerned shall wherever possible participate in the benefit of such activities and shall receive fair compensation for any damage which they may sustain as a result of such activities. Article 16 (2) clearly mentions that where the relocation of these peoples is considered necessary, exceptional measures such as relocation shall take place only with their free and inform consent. Where their consent cannot 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.

2.5 Air and Water Standards

Relevant ambient air and water quality standards are presented in Tables 2.1 and 2.2. The ambient air quality network in Nepal is limited to stations in the Kathmandu urban area and a remote station near Mt. Everest. The operation of the stations in the Kathmandu area has been at risk due to electricity shortages.[7] Analytical capacity is also limited to laboratories in the Kathmandu area. Nepal is developing a hazardous waste management regulatory system but it is not yet fully operational.

Table 2.1: National Ambient Air Quality Standards (micrograms per cubic meter)

Parameters	Averaging Time	Ambient Concentration (maximum)	Test Methods
Total Suspended Particulates	Annual	-	
	24-hours[a]	230	High Volume Sampling
PM10	Annual[b]	-	
	24-hours[a]	120	Low Volume Sampling
Sulphur Dioxide	Annual	50	Diffusive Sampling based on weekly averages
	24-hours[c]	70	To be determined before 2005
Nitrogen Dioxide	Annual	40	Diffusive Sampling based on weekly averages
	24-hours[c]	80	To be determined before 2005
Carbon Monoxide	8 hours[b]	10,000	To be determined before 2005
	15 minutes	100,000	Indicative Samplers[d]
Lead	Annual	0.5	Atomic Absorption Spectrometry, analysis of PM10 samples[c]
	24-hours	-	
Benzene	Annual	20[e]	Diffusive Sampling based on weekly averages
	24-hours	-	

Source: (MoEN, 2010)

Notes:

[a] 24 hourly values shall be met 95% of the time in a year. 18 days per calender year the standard may be exceeded but not on two consecutive days

[b] If representativeness can be proven, yearly averages can be calculated from PM10 samples from selected weekdays from each month of the year.

[c] 24 hourly standards for NO_2 and SO_2 and 8 hours standard for CO are not to be controlled before MOPE has recommended appropriate test methodologies. This will be done before 2005.

[d] Control by spot sampling at roadside locations: Minimum one sample per week taken over 15 minutes during peak traffic hours, i.e in the period 8am-10am or 3pm-6pm on a workday. This test method will be re-evaluated by 2005.

[e] To be re-evaluated by 2005

Table 2.2: Generic Standard: Tolerance Limit for Industrial (Wastewater) Effluents Discharged into Inland Surface Waters and Public Sewers

[7] Nepal Ministry of Environment. *A Brief Note on Environmental Pollution Control and Monitoring.* Accessed on 10 June 2011 from: http://www.moenv.gov.np/newwebsite. The air quality network was established with funding from the Danish government. According to this note, the most recent air quality monitoring report covered years 2006-2007, and the monitoring system was shut down due to load shedding.

SN	Parameters	Industrial waste into Inland Surface Waters	Wastewater into inland Surface Waters from CWTP*	Industrial Effluents into Public Sewers*
1	TSS, mg/l	30-200	50	600
2	Particle size of TSS	Shall pass 850-micron Sieve	Shall pass 850-micron Sieve	
3	pH Value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
4	Temperature ^{o}C[1]	<40	<40	45
5	TDS, mg/L, max			2100
6	Colour and Odour			
7	BOD for 5 days at 20 degree C, mg/L Max	30-100	50	400
8	Oils and grease, mg/L, Max, Max	10	10	50
9	Phenolic compounds, mg/	1	1	10
10	Cyanides (as CN), mg/L, Max	0.2	0.2	2
11	Sulphides (as S), mg/L, Max	2	2	2
	Sulphates (SO_4), mg/L, Max			500
12	Radioactive materials: a. Alpha emitters, c/ml, Max b. Beta emitters, c/ml, Max	 10^{-7} 10^{-8}	 10^{-7} 10^{-8}	
13	Insecticides	Absent	Absent	Absent
14	Total residual chlorine, mg/L	1	1	1000 as chlorides
15	Fluorides (as F), mg/L, Max	2	2	10
16	Arsenic (as AS), mg/L, Max	0.2	0.2	1
17	Cadmium (as, Cd), mg/L, Max	2	2	2
18	Hexavalent chromium (as Cr), mg/L, Max	0.1	0.1	2
19	Copper (as Cu), mg/L, Max	3	3	3
20	Lead (as Pb), mg/L, Max	0.1	0.1	0.1
21	Mercury (as Hg), mg/L, Max	0.01	0.01	0.01
22	Nickel (as Ni), mg/L, Max	3	3	3
23	Selenium (as Se), mg/L, Max	0.05	0.05	0.05
24	Zinc (as Zn), mg/L, Max	5	5	5

Table 2.2: Generic Standard: Tolerance Limit for Industrial (Wastewater) Effluents Discharged into Inland Surface Waters and Public Sewers

SN	Parameters	Industrial waste into Inland Surface Waters	Wastewater into inland Surface Waters from CWTP*	Industrial Effluents into Public Sewers*
25	Sodium, %, max			
26	Ammonical nitrogen, mg/L, Max	50	50	50
27	COD, mg/L, Max	250	250	250
28	Silver, mg/L, Max	0.1	0.1	0.1
29	Mineral Oils, mg/L, Max			10
30	Inhibition of nitrification test at 200ml/l			<50%

Source: MOEN, 2010

Notes: CWTP= Combined Waste Water Treatment Plant; Under enforcement since BS 2058/1/17 (30 April 2001); *Under enforcement since BS 2060/3/9 (23 June 2003); [1] Shall not exceed 40^{o}C in any section within 15 m downstream from the effluent outlet

2.6 Asian Development Bank Safeguards

Under the ADB *Safeguard Policy Statement 2009* (SPS 2009), environment Category B has been confirmed for the Project. The Project is classified as resettlement category A, since some land acquisition and resettlement may be required for the project; and is classified as indigenous peoples category B. This environmental assessment has been carried out in accordance with SPS 2009, with specific attention to Appendix 1, paragraph 12, which states

> *The level of detail and complexity of the environmental planning documents and the priority of the identified measures and actions will be commensurate with the project's impacts and risks. Key considerations include mitigation of potential adverse impacts to the level of "no significant harm to third parties", the polluter pays principle, the precautionary approach, and adaptive management.*

SPS 2009 environment policy principal number 9 states:

> Apply pollution prevention and control technologies and practices consistent with international good practices as reflected in international recognized standards such as the World Bank Group's Environmental, Health, and Safety Guidelines. Avoid pollution, or when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges, including direct and indirect greenhouse gas emissions, waste generation, and release of hazardous materials from their production, transportation, handling, and storage. Avoid the use of hazardous materials subject to international bans or phaseouts. Purchase, use, and manage pesticides based on integrated pest management approaches and reduce reliance on synthetic chemical pesticides.

Pursuant to policy principle number 9, applicable Nepali regulatory requirements are complemented by the World Bank Group's *Environmental Health and Safety Guidelines for Electric Power Transmission and Distribution*.

A key concern of ADB is that the Project does not result in degradation of sensitive ecosystems including critical and natural habitat. SPS 2009, Appendix 1, paragraph 27, states that "*the project mitigation measures should be designed to achieve at least no net loss of biodiversity*," which could be achieved by post-project restoration of habitats or "*through the creation or effective conservation of ecologically comparable areas,*" i.e. an ecological "offset." SPS 2009 provides the working definition of critical habitat as: habitat required for the survival of (i) globally endangered and/or critically endangered species, (ii) nationally endangered or critically endangered species, (iii) endemic/restricted range species, and (iv) migratory/congregatory species. Any Important Bird Areas (IBA) should be considered as critical habitat until further study identifies it is not. The overall Annapurna Conservation Area (ACA) and other legally protected areas are considered to be critical habitat for the threatened species they support, however, factors such as elevation and land use zoning create discrete habitat management units for each species within the overall area. The intensive land use zone in ACA has potential to be critical habitat with respect to clouded leopard, Himalaya muskdeer, and the Himalayan wood mouse (see further discussion in sections 4 and 5).

As noted above at section 2.3, the Conservation Area Management Rules allow for infrastructure development on a case-by-case basis, if EIAs demonstrate that impacts can be avoided and/or mitigated. This regulatory approach is consistent with ADB SPS 2009. The Project is designed to avoid, minimize, and mitigate negative impacts and is expected to have lesser impacts in the project area relative to other infrastructure (such as roads). Impacts and mitigation measures are discussed in Sections 5 and 7.

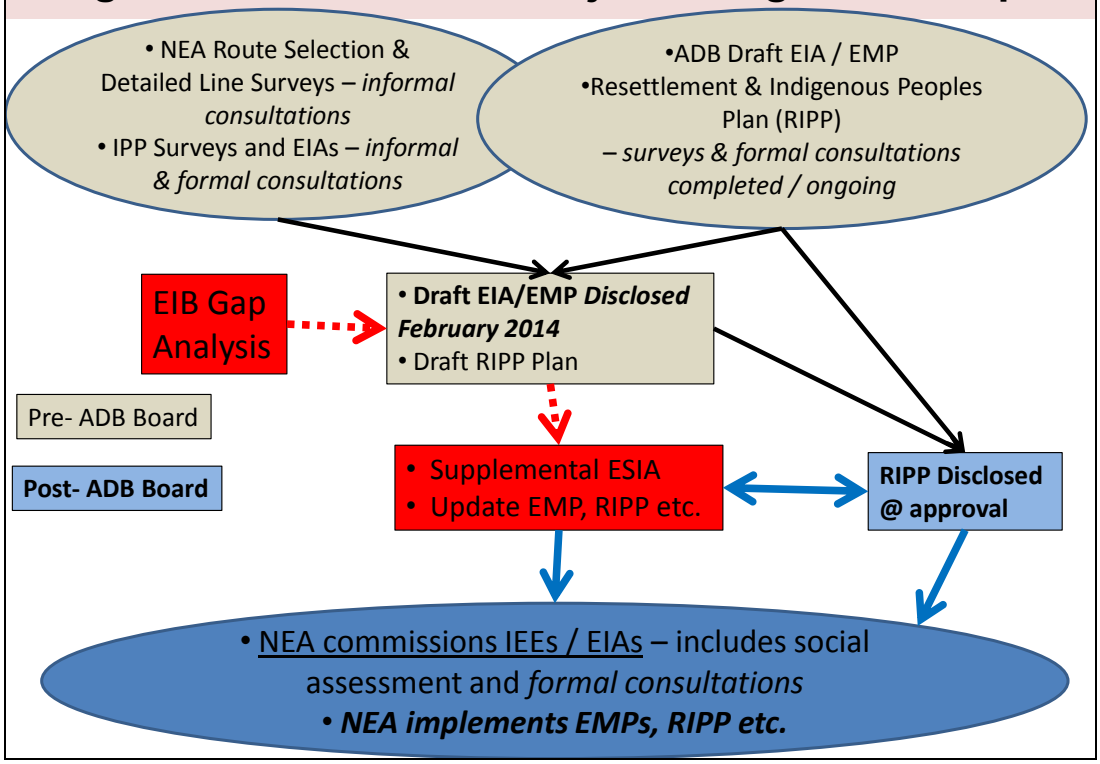
2.7 Environmental and Social Safeguards Activities for the Project

Under the Nepal environmental regulatory framework, the NEA will obtain survey and transmission licenses for individual transmission lines rather than for the entire Project, and each proposed transmission line requires an IEE, or an EIA for lines in protected areas; these IEEs and EIAs include social impact assessments. [The required IEE for the Markichowk-Kathmandu line has been completed. The Nepal regulatory framework does not require environmental assessments for the proposed distribution output; therefore the distribution system subprojects are covered in accordance with ADB SPS 2009.

The Project includes a 25 kilometer (km) transmission line from Manang to Khudi, with substations at either end, which all lie within the Annapurna Conservation Area (ACA); an EIA will be required for this transmission line and substations. The Manang-Khudi line and substations are not scheduled to go into service until 2019, with construction expected to commence in 2 years prior to operations; thus, there are more than 2 years to complete the EIA prior to construction. For other transmission lines, the earliest construction activities are expected to begin in early 2015, allowing about 1 year to complete IEEs. Thus, this report serves as input to the IEEs and EIA for the individual transmission lines to completed going forward.

The European Investment Bank (EIB) is considering cofinancing the Project. EIB has its own environmental and social safeguards, and will review the environmental and social assessments prepared on behalf of NEA. EIB may commission supplemental safeguards analyses prior to preparation of the IEEs and EIA required under the Nepali framework. Figure 2.1 illustrates the overall safeguards activities which will be conducted.

Figure 2.1: ADB SPEP Project Safeguards "Map"



3. Description of the Project

The proposed South Asia Subregional Economic Cooperation (SASEC) Power System Expansion Project (SPEP, the Project) is included in the Asian Development Bank (ADB) Country Partnership Strategy 2010-2012 for Nepal, and the Country Operations Business Plan 2013-2015.

Project Outputs. The project includes 4 outputs:

(i) Output 1. Power transmission capacity increase comprising: (a) construction and augmentation of 45 kilometers (km) of 400 kilovolt (kV) and 191.5 km of 220 kV transmission lines along Kali Gandaki corridor; (b) construction or augmentation of 500 megavolt-ampere (MVA) of 400 kV/220 kV/132 kV, 500 MVA of 220 kV/132 kV/33 kV, and 120 MVA of 33 kV/11 kV grid substations along Kali Gandaki corridor and Marsyangdi-Kathmandu route; and (c) construction or replacement of grid service substations with an aggregated capacity of 393.8 MVA across the country.[8]

(ii) Output 2. Power distribution network improvements comprising the construction and upgrading of 410 km of 33 kV, 545 km of 11 kV, and 725 km of 400 V distribution lines, and distribution substations of 216 MVA in East, Central and West regions.

(iii) Output 3. Mini-grid based renewable energy (RE) systems in off-grid areas increased. This includes installation of up to 4.3 MW of aggregated mini hydro-electric power plants and up to 0.5 MW of aggregated mini-grid based solar or solar/wind hybrid systems, in selected rural communities, through the provision of (a) a credit line of $5 million from ADB's Special Funds to user communities for mini-hydro power plants and (b) a $10 million grant from the Strategic Climate Fund (SCF) [9] administered by ADB. [10]

(iv) Output 4. Capacity development support to the Nepal Electricity Authority (NEA) and the Alternative Energy Promotion Center (AEPC). The physical investments will be reinforced and supplemented by capacity building support to NEA and AEPC, including project management support, preparation of distribution system/rural electrification master plan and feasibility study of utility level wind farm, and parallel livelihood development activities in the project area.

Project implementation services will be provided, including support for design, bid specifications, procurement, environmental and social safeguards implementation, and livelihood improvement in the transmission corridors.

Rationale and Need for the Project

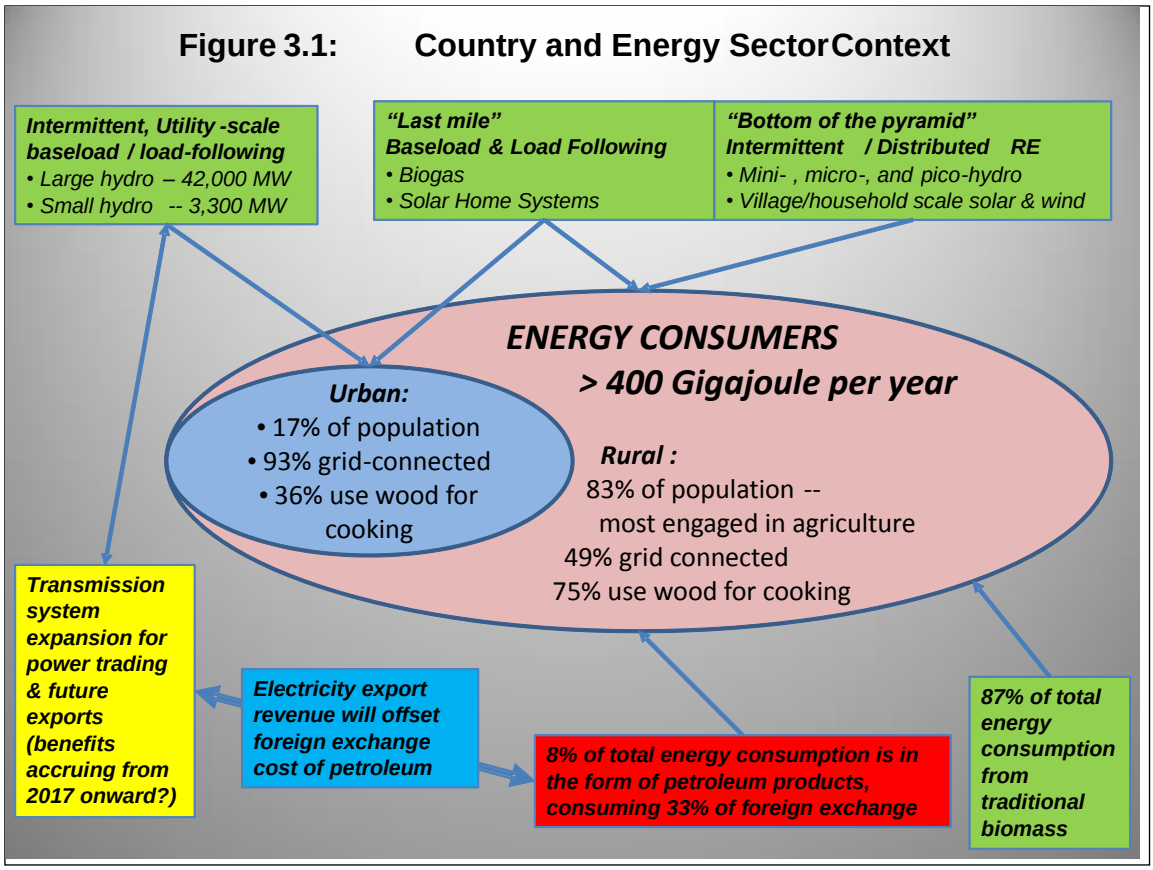
[8] In addition, EIB will cofinance the construction of 125 km of 220 kV transmission line and 400 MVA of 220 kV/132 kV/33 kV substations at Marsyangdi corridor, and 24 km of 132 kV transmission line, and 30 MVA 132 kV/33 kV and 6/8 MVA of 33 kV/11 kV substations at Samundratar-Trishuli 3B transmission hub.

[9] SCF is one of ADB's multi-donor trust funds under the Climate Investment Funds, administered by ADB.

[10] Outputs 3 and 4 will be implemented as integral parts of the National Rural Renewable Energy program (NRREP).

The Project is designed to address Nepal's overall energy development, in particular the urgent needs of the Nepal power system. Lack of investment in generation, transmission, and distribution has led to unreliable and inadequate power supplies. The majority of the population still relies on traditional biomass (animal dung, agricultural residues, and wood) for basic energy needs, mainly cooking and heating. Traditional biomass accounted for 86% of total final energy demand in 2006. Per capita gross domestic product and per capita energy demand are among the lowest of South Asian countries. The electrification rate is about 33%, among the lowest in Asia, and about the same as Bangladesh and Bhutan.[11] Agricultural, commercial, and residential uses account for most electricity consumption. The country and sector context is presented in Figure 3.1.

Figure 3.1: Country and Energy Sector Context



The Project targets the strengthening and expansion of transmission and distribution systems that will enable Nepal to further benefit from power trading and development of its abundant hydropower resources. Transmission network strengthening and expansion, in conjunction with current hydropower generation development, is a precondition to reducing load shedding and increased cross border electricity trade. The project components are presented in Tables 3.1 and 3.2, and shown schematically in Figure 3.2.

The transmission subprojects will connect new associated hydropower plants to the grid. These associated facilities and their development status are listed in Table 3.3. The hydropower projects must obtain survey licenses, prepare EIAs (if greater than 5 MW capacity), and secure power purchase agreement (PPA) prior to construction; an EIA is

[11] ADB. 2009. *Energy Outlook 2009*. Manila.

required before a generation construction license is issued, and all of these steps are normally completed before financing can be secured. The projects in the development queue have total capacity of 976 MW in the Kaligandaki corridor (92.3 MW with power purchase agreements (PPA) in place), 1620 MW in the Marsyangdi Corridor (119 MW with PPAs), and 38 MW in the Samundratar-Trishuli 3B corridor (27 MW with PPAs). The following are "under construction" now: (i) 50 MW Upper Marsyangdi "A"; (ii) 4.4 MW Radhi Khola plant; (iii) 11.2 MW Thapa Khola; (iv) 20 MW Lower Modi; and (v) 42 MW Mristi Khola. All of these hydro projects have a generation construction license issued by the Nepali Department of Electricity Development (DOED). The list of projects with construction licenses is available at this link:
http://www.doed.gov.np/construction_license_for_generation.php

Table 3.1: Project Outputs 1 and 3

Outputs	Details
Output 1: NEA Transmission System Expansion	
1. Kali Gandaki basin to border	i. Dana - Kusma 220kV transmission line, and substations at Dana, Kusma; ii. Kusma - New Butwal 220kV transmission line, and substation at New Butwal; iii. New Butwal - Bardaghat 400kV transmission line, and substation at Bardaghat;
2. Marsyangdi Corridor	i. Khudi- Udipur- Marki Chowk- Bharatpur 220kV transmission line, and substation at Khudi, switchyard at Udipur, and bay extension at Bharatpur; ii. Manang-Khudi 220kV transmission line, and associated substations at Manang and bay extension at Khudi
3. Marsyangdi to Kathmandu	**i.** Marki Chowk- Matatirtha- 220kV transmission line, and associated Marki Chowk substation, and bay extension at Matatirtha;
4. Grid substations reinforcement	i. Gandak 132/33/11kV (30MVA+16.6MVA); Middle Marsyangdi 132/33kV (20MVA); Butwal 132/33 (63MVA); Bharatpur 132/33kv (63MVA); Dhalkebar 132/33kV (63MVA); Lahan 33/11kV (2*16.6MVA); Banepa 66/11kV (2*22.5MVA); Attaria 132/33kV (2*30MVA)
Output 3: AEPC mini-grid based RE development	
1. Mini hydropower mini-grid development	i. Sani Veri Mini HPP (300 kW) ii. Simurutu Mini HPP (200 kW), and others
2. Solar power and solar-wind power hybrid mini-grid development	i. Kyangshing Solar Mini grid (12.6 kW) ii. Bhorleni Solar-wind hybrid mini-grid (35 kW) iii. Chisapani Solar-wind hybrid mini-grid (20 kW) and others

kV = kilovolts, kW = kilowatts, MVA = megavolt-amperes

Source: ADB review mission Aide Memoire, February 2014.

Table 3.2: Project Output 2 -- Distribution Subprojects

No.	Project/ District	33 kV line (km)	11 kV line (km)	Transformers (number)	400 V (km)	Substation (MVA)	Region
Package 1: Distribution System Augmentation in East Region							
1	Juropani S/S, Jhapa	20	20	10	20	8	East
2	Ghailadubba S/S, Jhapa	10	20	10	20	8	East
3	Ranke S/S, Ilam	-	20	10	20	8	East
4	Hasandaha S/S, Morang	15	20	10	20	8	East
5	Katahari S/S, Morang	15	15	10	20	8	East
6	Sakranti Bazaar S/S, Tehrathum	5	20	10	20	3	East
7	Bhojpur, Ranibas S/S, Bhojpur	-	15	10	20	3	East
8	Bhojpur- Baikunthe-WasingTharpu	35	20	20	40	3	East
9	Baksila S/S, Khotang	20	10	10	20	3	East
10	Bisanpur S/S, Saptari	10	15	10	20	8	East
11	Upgradation of Fikkal S/S, Ilam	-	20	6	20	8	East
12	Upgradation of Bishnupur (Siraha) S/S,	-	5	5	10	8	East
13	Upgradation of Balardaha S/S, Saptari	-	5	10	5	8	East
14	DSR at Tehrathum ,Taplejung District	-	20	20	40	-	East
15	DSR at South Parts of Jhapa District	-	-	15	30	-	East
16	DSR in Rajbiraj and Lahan	-	15	10	20	-	East
17	DSR in Itahari , Biratnagar and Belbari	30	20	25	50	-	East
18	DSR in Damak, Birtamod and Surunga	-	30	25	50		East
19	Dharan- Dhankuta- Hile 33 kV line	70	-	-	-	-	East
	TOTAL	**230.00**	**290.00**	**226.00**	**445.00**	**84.00**	

Table 3.2: Project Output 2 -- Distribution Subprojects (continued) -- Package2 - Central and West Regions

No.	Project/ District	33 kV (km)	11 kV (km)	Transformers (no.)	400 V(km)	Substation(MVA)	Region
1	Chhatiwan S/S, Makawanpur	20.00	10.00		20.00	8.00	Central
2	Laharepauwa S/S, Rasuwa	20.00	10.00	10.00	10.00	3.00	Central
3	Maulapur S/S, Rautahat	15.00	15.00	10.00	20.00	8.00	Central
4	SedhwaS/S Parsa	20.00	20.00	10.00	20.00	8.00	Central
5	Palungtar S/S Gorkha	10.00	25.00	15.00	30.00	8.00	West
6	Galkot S/S, Baglung	5.00	10.00	10.00	10.00	3.00	West
7	Derbang S/S Myagdi	25.00	10.00	10.00	10.00	3.00	West
8	Bulingtar SS Nawalparasi	25.00	20.00	10.00	20.00	3.00	West
9	DhakdhahiS/S Rupandehi	20.00	20.00	20.00	20.00	8.00	West
10	Lapani S/S Kapilbastu	10.00	20.00	15.00	20.00	8.00	West
11	Bijuwar S/S Pyuthan	5.00	20.00	20.00	10.00	8.00	West
12	Sulichaur S/S Rolpa	5.00	20.00	20.00	10.00	8.00	West
13	Upgradation of Aurahi S/S, Mahottari	-	5.00	10.00	10.00	8.00	Central
14	Upgradation of Haripur S/S, Sarlahi	-	5.00	10.00	10.00	8.00	Central
15	Upgradation of Sindhuli S/S, Sindhuli	-	5.00	10.00	10.00	8.00	Central
16	Upgradation of Butwal Rajmarg S/S	-	5.00	-	-	8.00	West
17	Upgradation of Bhairahawa SS	-	5.00	-	-	16.00	West
18	Upgradation of Bharaulia SS, Rupandehi	-	5.00	-	-	8.00	West
19	DSR at Pokhara, Kaski	-	25.00	25.00	50.00	-	West
20	DSR in Gorkha, Tanahu, Lamjung, Syanja, Baglung and Parbat						West
21	DSR at Kawasoti to Danda Bazaar						West
22	DSR at Mukundapur to Gaindakot Bazaar						West
23	DSR at Krishnanagar to Chandrauta						West
24	Butwal to Bhairahawa conductor upgrading						West

Table 3.2: Project Output 2 -- Distribution Subprojects (continued)

	33 kV (km)	11 kV (km)	Transformers (no.)	400 V(km)	Substation(MVA)
TOTAL – Central and West Regions	**180.00**	**255.00**	**205.00**	**280.00**	**132.00**
Grand Total	**410.00**	**545.00**	**431.00**	**725.00**	**216.00**

Table 3.3: Associated Hydropower Development Status

Kaligandaki Corridor

No.	Name of Company	Name of Project	Location	Capacity (kW)	Date of PPA	COD / RCOD	Actual Status	Transmission Line
1	Robust Energy Pvt. Ltd.	Mistri Khola	Myagdi	42,000	3-Feb-11	16-May-16	Under construction; EIA completed	Dana-Kushma 220kV
2	Mount Kailash Energy Pvt. Ltd.	Thapa Khola	Myagdi	11,200	25-Jan-11	19-May-14	Under construction, financial closure achieved, commissioning may be delayed by 6 months	Dana-Kushma 220 kV
3	Cemat Power Development Company (P). Ltd.	Ghalendi Khola	Myagdi	4,000	12-Apr-13	1-Jul-17	No progress yet, waiting for the construction of transmission corridor	Dana-Kushma 220 kV
4	Middle Modi Hydropower Ltd.	Madya Modi	Parbat	15,100	6-Dec-12	17-Sep-17	Construction not yet started	Kushma-Butwal 220 kV
5	Manang Trade Link Pvt. Ltd.	Lower Modi	Parbat	20,000	6-Sep-11	2-Oct-15	Under construction, commissioning expected in 2016	Kushma-Butwal 220 kV
	Total Capacity (kW)			**92,300**				

Table 3.3: Associated Hydropower Development Status (continued)

Kaligandaki Corridor

No.	Name of	Name of	Location	Capacity	Date of PPA	COD / RCOD	Actual Status	Transmission Line

	Company	Project		(kW)				
	Survey license (SL) issued but PPA not yet signed				**Date of SL**			
6	Trade Link Global Pvt. Ltd.	Upper Kaligandaki	Myagdi	456,000	2-Jan-09			Dana-Kushma 220 kV
7	Tundi Power Company Pvt. Ltd.	Rahughat Mangale	Myagdi	37,000	1-Oct-08			Dana-Kushma 220 kV
8	Niligiri Khola Hydropower Company Ltd.	Nilgiri Khola	Myagdi	38,000	22-Aug-08			Dana-Kushma 220 kV
9	Hym Consult	Rele Khola	Myagdi	6,000	24-Feb-12			Dana-Kushma 220 kV
10	Pakhapani Hydropower Pvt. Ltd.	Thadekhani Khola	Myagdi	5,000	17-Nov-09			Dana-Kushma 220 kV
11	Pradip Sapkota	Bagar Khola	Myagdi	7,100	6-Jan-09			Dana-Kushma 220 kV
12	Myagdi Hydrpower Pvt. Ltd.	Ghar Khola	Myagdi	8,300	3-Dec-08			Dana-Kushma 220 kV
13	Dhulagiri Kalika Hydropower Pvt. Ltd.	Durbhang Myagdi Khola	Myagdi	27,000	27-Mar-09			Dana-Kushma 220 kV
	Total Capacity (kW)			**584,400**				

Table 3.3: Associated Hydropower Development Status (continued)

Kaligandaki Corridor

No.	Name of Company	Name of Project	Location	Capacity (kW)	Date of PPA	COD / RCOD	Actual Status	Transmission Line

	Survey License Pending							
	NEA	Uttar Ganga	Baglung	300,000				Kushma-Butwal 220 kV
	Kaligandaki Corridor Total (kW)			**976,700**				

Marsyangdi Corridor

No.	Name of Company	Name of Project	Location	Capacity (kW)	Date of PPA	COD / RCOD	Actual Status	Transmission Line
1	Sinohydro-Sagarmatha Power Co. (P). Ltd.	Upper Marsyangdi A	Lamjung	50,000	29-Dec-10	17-Sep-16	Under construction, likely to be commissioned as per RCOD; EIA completed	Khudi – Udipur - Marki Chowk 220 kV
2	Radhi Bidyut Company Ltd.	Radhi Khola	Lamjung	4,400	1-Feb-10	13-Apr-13	Under construction, > 50% completed, likely commissioning in 2013/14	Khudi – Udipur – Marki Chowk 220 kV
3	Chyangdi Hydropower Pvt. Ltd.	Chyangdi	Lamjung	1,700	5-Apr-12	31-Aug-15	Not yet started	Khudi – Udipur - Marki Chowk 220 kV
4	Himalayan Power Partner Pvt. Ltd.	Dordi Khola	Lamjung	27,000	15-Jun-12	15-Jun-17	Waiting for construction of transmission corridor	Khudi – Udipur - Marki Chowk 220 kV
5	Liberty Hydropower Pvt. Ltd.	Upper Dordi A	Lamjung	22,000	18-Sep-12	14-Oct-16	Waiting for construction of transmission corridor	Khudi – Udipur - Marki Chowk 220 kV

Table 3.3: Associated Hydropower Development Status (continued)

Marsyangdi Corridor

No.	Name of Company	Name of Project	Location	Capacity (kW)	Date of PPA	COD / RCOD	Actual Status	Transmission Line
8	Union	Midim Karpu	Lamjung	3,000	10-Feb-13	15-Jun-14	Waiting for construction	Khudi – Udipur -

	Hydropower Pvt. Ltd.						of transmission corridor	Marki Chowk 220 kV
9	Bidhyabasini Hydropower Dev.Co. PVT. Ltd.	Rudi A	Lamjung	6,800	10-Feb-13	16-Jul-16	Waiting for construction of transmission corridor	Khudi – Udipur - Marki Chowk 220 kV
10	Tallo Midim Jalbidyut Company (P) Ltd.	Lower Midim	Lamjung	996	2-May-13	17-Nov-14	Not started	Khudi – Udipur - Marki Chowk 220 kV
	Total Capacity (kW)			**119,346**				
	Survey license (SL) issued but PPA not yet signed				**Date of SL**			
	Butwal Power Company	Lower Manang Marsyangdi	Manang	140,000	25-May-09			Manang – Khudi 220 kV
	Multi Model Developers Pvt. Ltd.	Upper Marsyangdi-1	Lamjung	150,000	30-Jul-08			Manang – Khudi 220 kV
	Peoples Hydrpower Company Pvt. Ltd.	Super Dordi Khola	Lamjung	49,600	1-Oct-08			Manang – Khudi 220 kV
	Dibyajyoti Hydropower Pvt. Ltd.	Marsyangdi Besi	Lamjung	50,000	16-Oct-08			Manang – Khudi 220 kV
	Myardi Khola Hydropower Company Pvt. Ltd.	Myardi Khola	Lamjung	30,000	14-Aug-08			Manang – Khudi 220 kV

Table 3.3: Associated Hydropower Development Status (continued)

Marsyangdi Corridor

No.	Name of Company	Name of Project	Location	Capacity (kW)	Date of PPA	COD / RCOD	Actual Status	Transmission Line
	Machha-	Dudhkhola	Manang	25,000	17-Sep-10			Manang – Khudi

	puchhare Hydropower Dev. Co.							220 kV
	Total Capacity (kW)			**444,600**				
	Survey License Pending							
	Manang Marsyangdi	Manang Marsyangdi	Manang	292,000				Manang – Khudi 220 kV
	NEA	Upper Modi 'A'	Kaski	47,000				TBC
	Upper Marsyangdi-2	Upper Marsyangdi-2	Lamjung	600,000				Manang – Khudi 220 kV
	Marsyangdi-3	Marsyangdi-3	Lamjung	42,000				
	Upper Khudi	Upper Khudi	Lamjung	26,000				
	Nyadi Khola	Nyadi Khola	Lamjung	50,000				
	Total Capacity (kW)			**1,057,000**				
	Marysangdi Corridor Total (kW)			**1,620,946**				
	Trishuli Corridor							
No.	**Name of Company**	**Name of Project**	**Location**	**Capacity (kW)**	**Date of PPA**	**COD / RCOD**	**Actual Status**	**Transmission Line**
1	Aadi Shakti Power Dev. Co.	Tadi Khola	Nuwakot	5,000	28-Mar-05	27-Mar-13	Already commissioned and in operation	Chaughada – Devighat 33 kV

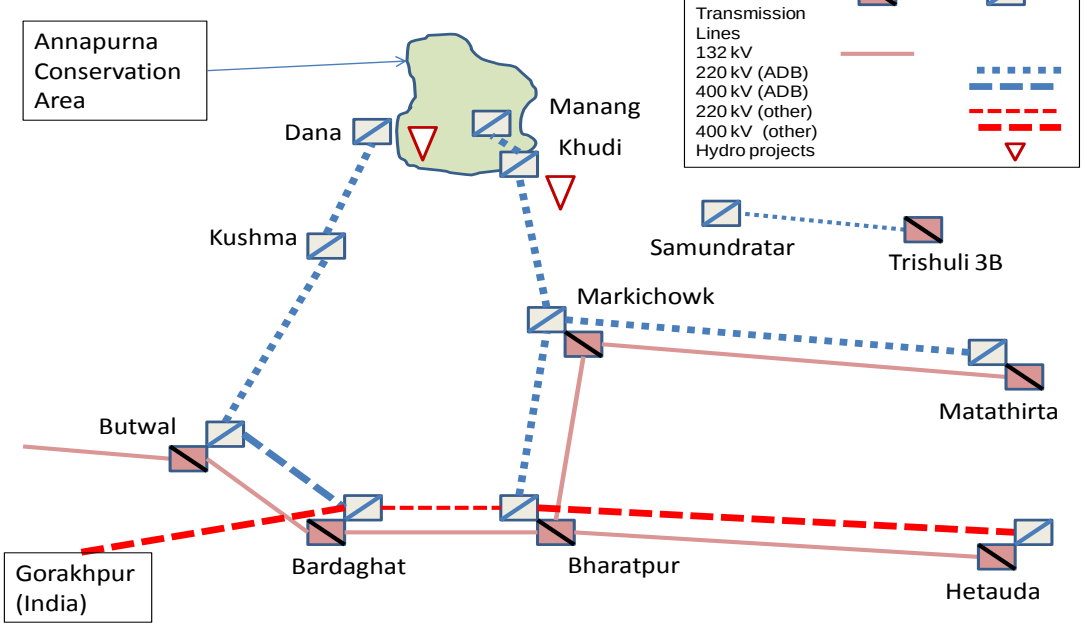
Table 3.3: Associated Hydropower Development Status (continued)

Trishuli Corridor

No.	Name of Company	Name of Project	Location	Capacity (kW)	Date of PPA	COD / RCOD	Actual Status	Transmission Line
2	Buddha Bhumi SHP	Tadi Khola	Nuwakot	5,000	-	-	Connection agreement concluded, generation	Samundratar – Trishuli 3B Hub

							license acquired.	132 kV
3	Hira Ratna	Tadi Khola	Nuwakot	5,000	22-Apr-10	16-Jul-13	PPA concluded, construction started	Samundratar – Trishuli 3B Hub 132 kV
4	Hira Ratna	Tadi Khola	Nuwakot	3,000	-	-	PPA not concluded	Samundratar – Trishuli 3B Hub 132 kV
5	Dupcheshwor Hydro Co. Ltd.	Middle Tadi	Nuwakot	5,000	26-Aug-12	15-Jun-14	PPA concluded, no financial closure yet	Samundratar – Trishuli 3B Hub 132 kV
6	Suryakanda Hydroelectric Co. Pvt. Ltd.	Upper Tadi	Nuwakot	11,000	16-Mar-12	9-Oct-16	PPA concluded	Samundratar – Trishuli 3B Hub 132 kV
7	Nobal Power Co.	Chake Khola	Nuwakot	1,800	-	-	Connection agreement concluded	Samundratar – Trishuli 3B Hub 132 kV
8	Chandrawati Power Co. Ltd.	Tadi Khola	Nuwakot	4,500	-	-	PPA concluded	Samundratar – Trishuli 3B Hub 132 kV
9	Salankhu Khola Hydropower Ltd.	Salankhu Khola	Nuwakot	2,500	30-Sep-12	14-Mar-15	PPA concluded	Samundratar – Trishuli 3B Hub 132 kV
Trishuli Corridor Total (kW)				**42,8000**			Waiting on construction of Samundratar – Trishuli 3B Hub 132 kV transmission line	

Figure 3.2: Transmission Subprojects



The major demand centers are in eastern and central Nepal. Large hydropower and associated transmission development programs in central Nepal and the Tamakoshi Valley in eastern Nepal are at an advanced stage of development with technical and financial support from ADB projects approved in 2013 and 2011.[12] At present, the highest priorities for development are the Marsyangdi and Kali Gandaki corridors which will serve the central Nepal demand center and enable cross-border power exchange between Bardaghat and Gorakhpur in India (see Figure 3.2).

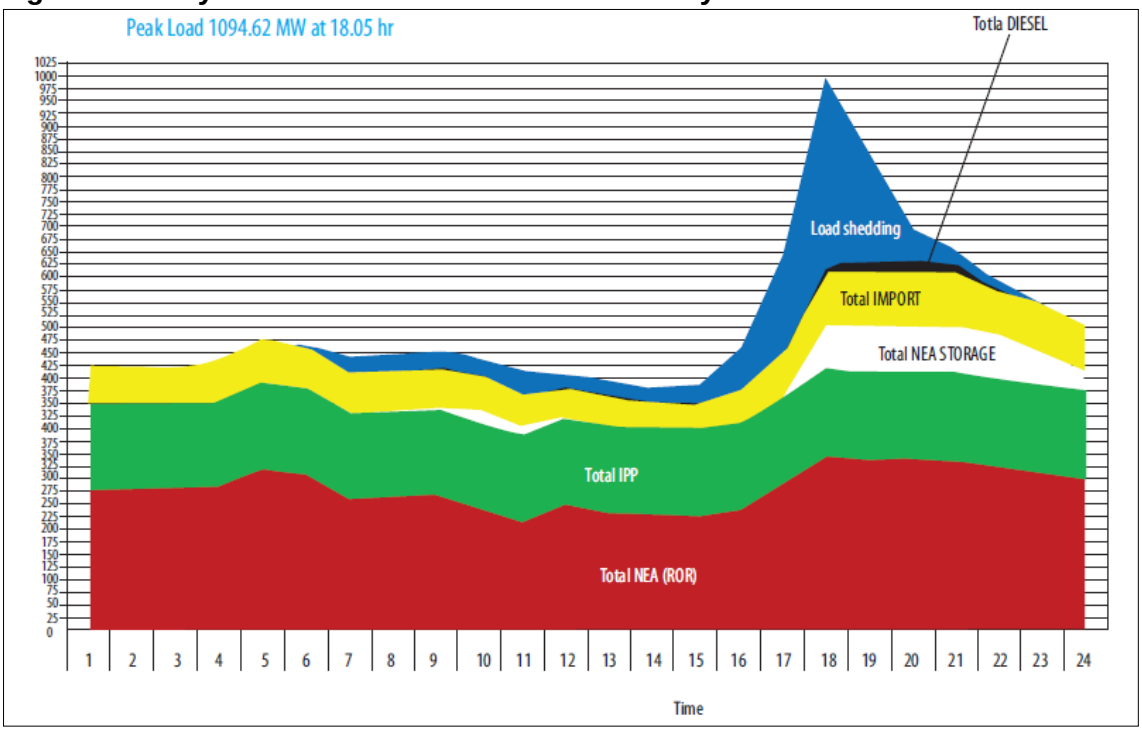
There is no large-scale, short-term, supply-side solution based on domestic resources, as large hydropower plants typically require 5 to 7 years for construction and commissioning. Improving end-use and grid operational efficiency and expanding distributed generation capacity will alleviate load shedding; these activities are being pursued with technical and financial support from ADB under a project approved in 2009.[13] NEA is implementing a program to reduce technical and non-technical losses. Increasing power imports from India presents the only supply-side solution which can be achieved at the scale necessary to close the demand-supply gap in a timely fashion.

The power sector presents the most severe infrastructure constraint for economic growth. Demand is projected to continue growing at 7.6% annually until 2020. Due to the shortfall in power delivery capacity, the NEA introduced scheduled service interruptions (load shedding or "rolling brownouts") of 12 hours per day in 2010. These conditions provide a major opportunity for supply side and demand side energy efficiency (EE) improvements, as well as for use of other renewable energy (RE) sources to provide immediate relief to the grid, however EE and RE potential (not including large hydropower) are insufficient to bridge the demand-supply gap in the near term. At present, there is a peak power deficit of about 500 MW on a daily basis, as

[12] *Tanahu Hydropower Project*. ADB Project 4328-013, approved in 2013. *Nepal Electricity Transmission Expansion and Supply Improvement Project*. ADB Project 41155-013, approved in 2011.
[13] *Nepal Energy Access and Efficiency Improvement Project.* ADB Project 40553-013.

shown in Figure 3.3.

Figure 3.3: System Load Curve for Peak Load Day



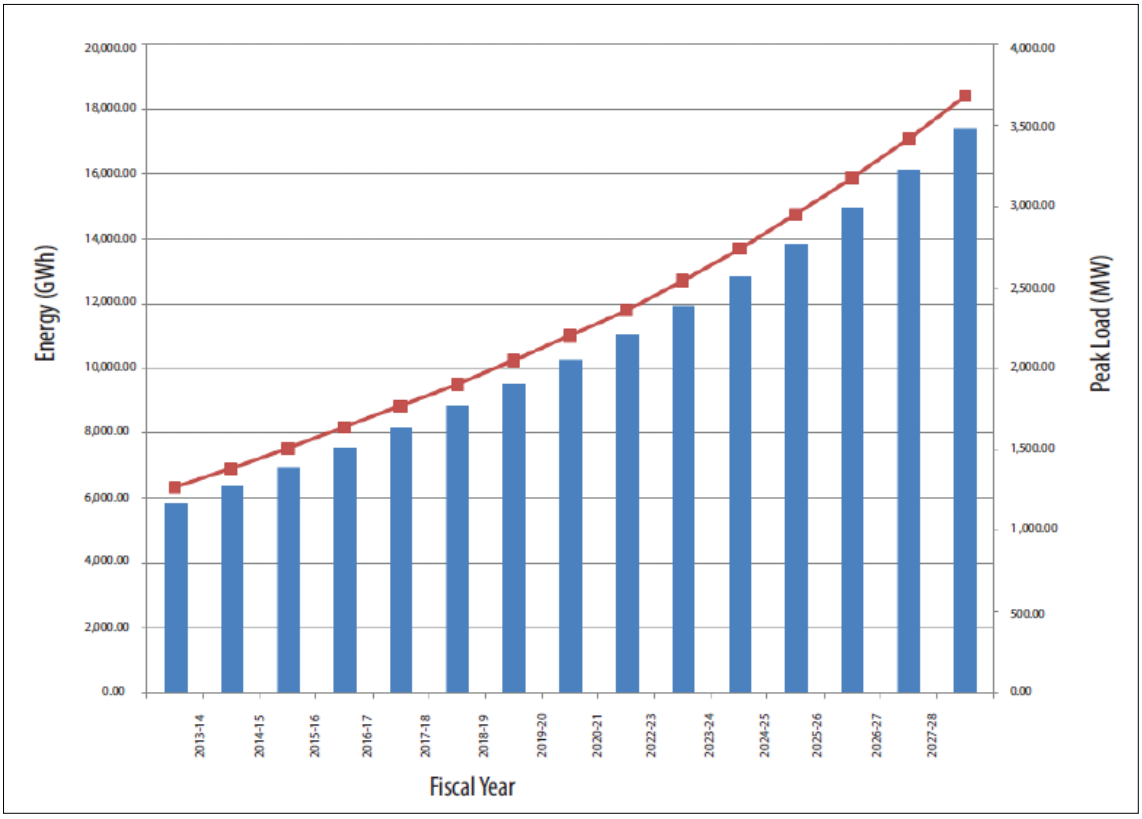
Source: Nepal Electricity Authority. 2013. *A Year In Review – Fiscal Year 2012/2013*. NEA, Kathmandu

Nepal's commercially exploitable hydropower potential is estimated to be 42,000 megawatts (MW).[14] The Government of Nepal plans to develop 10,000 MW of this resource during the near- to medium term, but the potential remains largely untapped with less than 1000 MW of installed capacity as of early 2014. Figure 3.4 shows the load forecast projected through year 2027-28 in terms of megawatts and gigawatt-hours.

A "chicken and egg" situation exists wherein private sector hydropower projects rely on the Nepal Electricity Authority (NEA) to provide adequate transmission capacity, without which future commercial investment will be discouraged. At the same time, NEA has limited funds and capacity for rapid expansion of the transmission network and new generation capacity. The Project will support the construction and operation of a national high-voltage transmission backbone which will facilitate expansion of electricity supply to consumers in Nepal, enhance voltage stability, and expand cross-border power trading capacity. In the near term, power trading will be mainly imports from India, with some export of wet season surplus power in the medium term. In the longer term, power trading will be mainly exports as a year-round daily power surplus is developed; however, this potential surplus will not be created unless the high-voltage transmission network is expanded to support large-scale hydropower development.

Figure 3.4: Electricity Load Forecast

[14] SAARC. March 2010. *SAARC Regional Energy Trade Study*. Kathmandu, Nepal



Note: Energy (GWh) is represented by blue bars; peak load (MW) is represented by the red squares and line. Source: Nepal Electricity Authority. 2013. *A Year In Review – Fiscal Year 2012/2013*. NEA, Kathmandu

The transmission lines will improve efficiency of transmission system operations, expand delivery of clean energy, and reduce end-users need for back-up generators which use petroleum-based fuels. The associated hydropower plants currently under construction will add 103 MW to the grid with about 451 GWh per year of additional energy. This represents about 10% of peak demand of 1095 MW, and almost 11% of the estimate peak energy demand of 5446 GWh in 2012/2013.[15] As shown in Table 3.3, there are numerous additional hydropower projects under development in the Kaligandaki and Marsyangdi corridors, with about 1000 MW of new capacity in each corridor. Because of the uncertainty in the associated hydropower commissioning schedule, the transmission lines will utilize advanced high-temperature low-sag conductors to facilitate ultimate capacity of at least 1000 MW in each of these corridors.

Improved quality and reliability of electricity supplies will reduce load shedding and the need for back-up generators, which in turn will reduce conventional air pollutant and greenhouse gas (GHG) emissions and improve local air quality with direct local health benefits. Expanding the delivery and use of clean energy will reduce GHG intensity (emissions per unit of economic output). Reducing demand for petroleum fuels for back-up power generation will reduce the foreign exchange outflow which is a serious drag on the economy as indicated in Figure 3.1.

Peak demand for electricity in Nepal overshot the installed capacity after 2007. This was followed by an increase in the ratio of imported petroleum products relative to

[15] Source: Nepal Electricity Authority. 2013. *A Year In Review – Fiscal Year 2012/2013*. NEA, Kathmandu

commodity exports from 57% in 2006/2007 to 126% in 2011/12. Similarly, sales of diesel doubled from 2008 to 2010 with increase in imports of captive generating sets from 56 MW in 2009 to 69 MW in 2012[16]. Based on Nepali Oil Corporation and NEA prices for petroleum fuels and electricity in 2012 and 2013, the monthly life cycle cost of cooking with electricity in urban households is 43% less than that of kerosene and 9% less than that of liquefied petroleum gas (LPG). In an earlier study done in 2001, productive energy-use cost was found to be the least for saw dust stove which was lower than cost of electricity, and kerosene was cheaper than both LPG and electricity[17]. As the price of crude oil has increased in the last several years, grid-supplied electricity is now cheaper than refined petroleum products.

Alternatives to the Proposed Project

There are no practical alternatives to the Project based on financial, economic, and environmental factors. New high-voltage transmission capacity is required to deliver power from the proposed transmission corridors into the national grid and to facilitate cross border power exchange.

No Action. In the "no project" scenario, the power system will continue to experience operational difficulties due to demand-supply gaps, poor quality of power, and reduced reliability of service to end-users. Load shedding and scheduled blackouts will increase, and reliance on back-up generators will increase without the project.

Improving End-use Efficiency and Expansion of Distributed Generation Capacity to Eliminate Need for High Voltage Transmission. Improvement of end-use efficiency in the near term could reduce demand by perhaps 5-10% or more. This would reduce, but not eliminate, the need for the Project due to the magnitude of suppressed demand. Distributed generation already exists in the form of backup generator sets fired with diesel or gasoline (petrol). ADB is providing technical and financial assistance for distributed generation with renewable resources via Output 3 of the Project, which is part of the larger NRREP. Distributed generation in the form of rooftop solar PV is being pursued and is included as a component of the ADB project approved in 2009, but solar PV is currently more expensive that grid-supplied hydropower. Solar PV is cost-competitive with off-grid petroleum-based generation, but has inherent limitations because it is has variable power output.

Expansion of generation capacity closer to major load centers e.g., the Tanahu hydropower project (for which ADB approved financing in 2013) would reduce but not eliminate the need for high voltage transmission and associated hydropower development. Small hydropower (less than 10 MW per plant) can fill some local demand-supply gaps in the near term, but requires mobilization of capital and additional investments to connect new hydropower plants to end-users and the grid.[18] Traditional biomass is currently used by the majority of the population of Nepal for basic energy needs, but upgrading with modern technology would be required to improve and increase the effective use of biomass. Geothermal potential has not been quantified. Wind potential requires site-specific wind monitoring prior to development, and utility-scale wind farms cannot be expected to come online fast enough to alleviate power shortages. Development of these other renewable resources could reduce the need for the Project in the short term, and would facilitate future exports of power as a

[16] Nakarmi, A. M. (2013, August 26). Power Requirements in Future Energy Scenarios of Nepal. *Power Summit 2013:Hastening pace of hydropower development*. Kathmandu, Bagmati, Nepal: IPPAN.

[17] Pokharel, S. (2004). Energy economics of cooking in households in Nepal. *Energy, 29*, 547-559.

[18] Small hydropower development is being pursued under Nepal's Scaling Up Renewable Energy Program (SREP) Investment Plan via a joint program of ADB's Private Sector Operations Department and the International Finance Corporation (IFC).

generation surplus develops in the long-term. Rehabilitation of existing hydropower plants will have similar benefit in the short-term and long-term.

Routing Alternatives for Transmission Lines

Routing alternatives for the proposed transmission lines have been evaluated to minimize line length, forest clearance, and sensitive ecosystems. For each transmission line, NEA conducts a preliminary desk study to identify the corridors, and evaluates 3 alternative routes within each corridor. The criteria utilized for comparison are based on accepted engineering, environmental, and social considerations. The preferred routing alternative minimizes the number of road crossings, river crossings, settlements affected, and minimizes forest crossings, thus minimizing the overall environmental and social impacts.

The preferred alternative. The proposed Project is consistent with least-cost expansion plans for electric power system operations in Nepal, and for improving access to energy in the proposed transmission corridors, with minimal environmental and social impacts. The proposed transmission lines are critical for delivery of clean energy to the major load centers of the country and to facilitate cross-border power trading. Other investments in end-use efficiency and distributed generation being implemented in parallel will complement the proposed Project, but would not provide sufficient energy savings and end-use generation to eliminate the need for the transmission components proposed.

4. Description of the Environment

4.1 Project Area and Boundaries

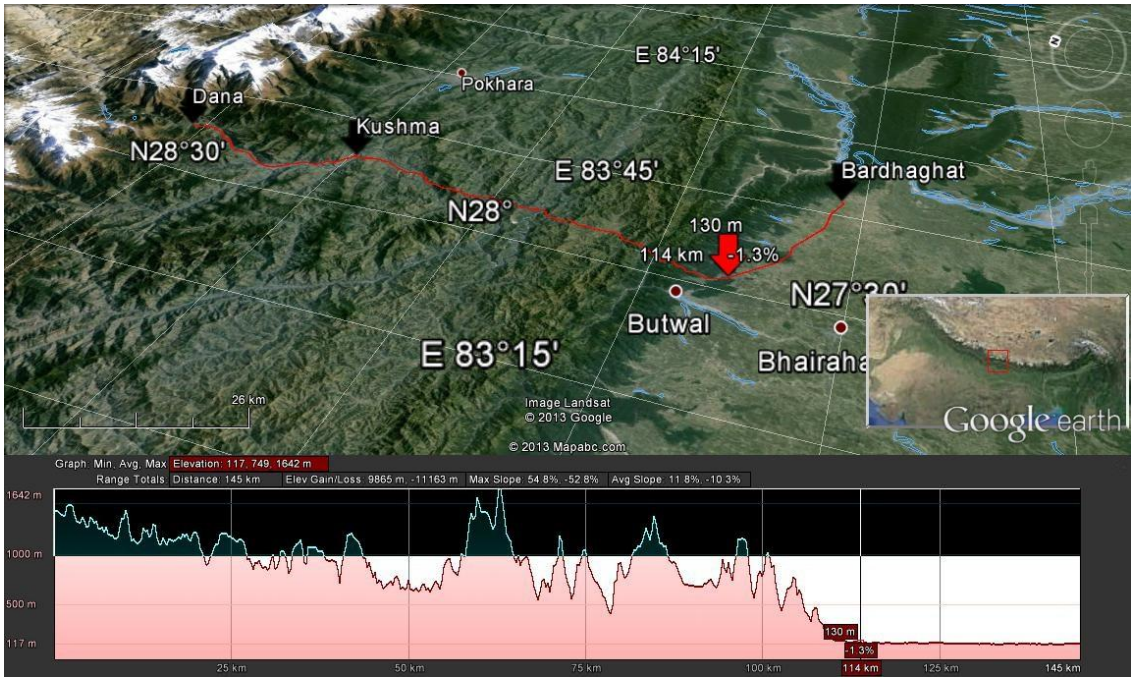
The Project transmission components are located mainly in the Western and Central Development Region in Nepal as shown in Figure 4.1 and 4.2. The distribution components are scattered throughout the country as shown in Figure 4.3

The Kaligandaki Corridor line will traverse a total of 155 km beginning approximately 50-km aerial distance northwest of Pokhara in Middle Mountains close to western boundary of Annapurna Conservation Area (ACA) to areas near Butwal, Lumbini and Chitwan National Park in the terai. In one section at Ghar VDC the routing crosses over to the left bank of Kaligandaki River and traverses for approximately 2.4 km inside the ACA. The Marsyangdi Corridor line will be routed to the east of Pokhara and will run from 40 km aerial distance north east of Pokhara from south eastern parts of the ACA to Bharatpur Municipality in inner terai of southern Nepal. Likewise, the Marsyangdi to Kathmandu line will 85 km run from Marki Chowk about 25 km from Pokhara to Kathmandu. The Trishuli 3B Transmission Hub consists of a 24 km transmission line and a substation at Samundratar, in an area northwest of Kathmandu and east of Pokhara.

[19] The grid service substations to be upgraded and the distribution system augmentation project sites are spread from Eastern to Far Western Development Region of Nepal.

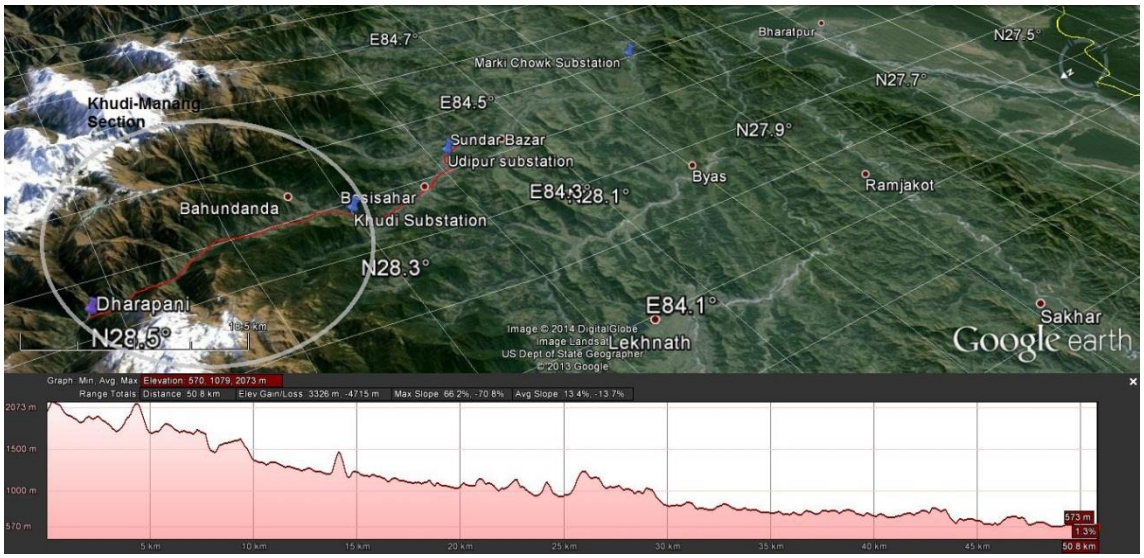
Figure 4.1 shows the approximate route of the Dana-Kushma-Butwal-Bardagaht (DKBB) route as a red line. Figure 4.2 shows the route of the Manang-Khudi-Markichowk-Bharatpur (MKMB) line is shown as a red line.

Figure: 4.1 Location Map and Elevation Profile of the Proposed Kaligandaki Corridor



[19] As of 19 February 2014, this line and substations are proposed to be dropped from the project.

Figure: 4.2 Location Map and Elevation Profile of the Proposed Marsyangdi Corridor



4.1.1. Kaligandaki Corridor

The project area for the DKBB[20] transmission line covers 46 Village Development Committees (the smallest administrative and political units of Nepal) of Seven Districts. The administrative units traversed by the transmission line are listed in Table 4.1. The transmission line at Dana, Tatopani, Ghar and Histan Mandali passes close to the ACA. Based on ACA Management Plan, a 2.4 km section of the line passes through the ACA occupying a footprint of 2.2 ha of cultivated land, 5.7 ha of forest Land (Schima Castonopsis Forest with 50 to 70% crown cover close to the Beni Jomsom Road) and 4.1 ha of barren or bushy areas (using 50m RoW). Furthermore, the transmission line crosses over three Corrugated Galvanised Iron (CGI) (this information have been included based on survey report of NEA) roofed house after AP 44. Similarly, at Rupandehi and Nawalparasi District the transmission line comes close to two World Heritage Sites, Lumbini and Chitwan National Park. The Butwal-Bardhaghat Section of the 400kV Line will tentatively be 25 km and 10 km from these protected and sensitive areas.

Table 4.1: Administrative units traversed by the DKBB Transmission Line

District Name	VDC Name	Settlements
Myagdi	Dana	Dana, Dwarikholagaun, Suwa
	Tatopani	Tatopani
ACA	Ghar	Pokharebagar, Ratopani
	Histan Mandali	Mahabhir
	Dowa	
	Beghkhola/Bagarkhola	Chhapa
	Rakhubhagwati	Nava Baishar, Risinge Chautari
	Piple	Ranipauwa
Parbat	MajhphantMallaj	Nepane, Kamidanda, Mallaj,

[20] The line includes substations at Dana, Kushma, Butwal and Bardaghat, hence the acronym DKBB is used to clearly distinguish it from other lines.

District Name	VDC Name	Settlements
		Phatkadhunga, Pachaiya, Lundi
	Dhairin	Bhedabari, Phausin
	Nanliban	Lasti, Wallo and Pallo Nanliban
	Pan	Bagaicha, Nuwar, Regmithok
	Khurkot	Bagaicha
	Mudikuwa	Sannesibagar
	Phalebas Devisthan	Bhusalchaur, Kajibaur
	Khurga	Chhadhai
	Panran	Shreekanbesi, Panran, Karnas
	Bachchha	Kaphleswara
	Uranpokhara	Salyan, Lugrin
	Wahakhi/Bahakithanti	Banipokara
	Saligram	Khabran, Chilaunekharka, Mithlan, Setibani
Baglung	Paiyupata	Dhad, Kharsedanda, Pathakthar, Paiyupata
	Amalachaur	Tallosarangi
Syangja	Pidikhola	Jogimara, Thangkharka
	Bagthala	Numbuwakharka
	ShreekrishnaGandaki	Bardanda, Ghyansindanda, Chap, Kyansyandi, Jaruwa
Palpa	Yamgha	Gunga
	Yarlamdanda	Lawadanda
	Chhapani	Balthumkidanda, Batulechaur, Phulun
	Nayarnamtales	Bagnas
	Chirtundhara	Piple
	Madanpokhara	
	Koldada	Jorpipal, Khamauri, Setai Berrena
	Dobhan	
Rupandehi	Devdaha	Budhar gau, Mudabas
	Markhar	
	Kerwani	Bhawanipur, Semarhawa
Nawalparasi	Sunwal	Asandiya
	Amraud	
	Swathi	Mukhyatol, Swathi,
	Ramnagar	Santapur, Harkatwa,
	Ramgram NP	
	Manari	Tilauli,
	Tilakpur	
	Panchnagar	Bhagyugani, Gainhara
	Makar	Betahani
Seven Districts	Fourty Six VDC's	

The DKBB line consists of 3 subprojects:

1. Dana-Kushma 220kV Line: This line will be routed from west of Annapurna Conservation Area next to a popular trekking route near Tatopani through 35km up to Kushma.
2. Kushma- Butwal 220 kV and New Butwal- Bardaghat 400kV Line: This line will be routed from Kushma for 75 km up to New Butwal 5 km east of Butwal

Municipality then reach Bardaghat 45 km east of New Butwal and 12 km North West of Indian border.

3. Associated 220kV and 400kV Substations: These substations will be located at Dana, Kushma, New Butwal and Bardhaghat.

4.1.2 Marsyangdi Corridor

The Project area of the Marsyangdi Corridor covers 12 VDCs of five districts. The administrative units traversed by the Manang-Khudi-Marki Chowk-Bharatpur (MKMB) transmission line are listed in Table 4.2. The transmission line will cross through the ACA at Manang District and Ghermu, Tagring (subject to change based on final detailed Survey Report) and Khudi VDC of Lamjung District. Similarly, near Bharatpur the transmission line will pass about 4 km away from Chitwan National Park.

Table 4.2: Administrative units traversed by the MKMB Line

District Name	VDC Name	Settlements
Manang	Dharapani	Dharapani, Khurke, Tal, Taldanda
Lamjung	Ghermu	Sat Talle Gaun, Ghermu, Chipla, Pudhakhale
	Tagring	Puranojagat, Chamche, Sitchaure, Thakan, Chhabise
	Bahundada	Nyaupane Phant
	Khudi	Thakan,Rabangaun, Dhakai Besari, Chhabise
	Bhulbhule	Bhulbhule
	Chandisthan	Badagaun, Goliyathok, Chanaute, Odare, Satbise
	Bajhakhet	Besisahar, Akkarbajar,
	Gaunsahar	Ranikuwa, Barhabise, Asimure, Tallophant, Dhipichaure, Rakse
	Udipur	Sanosimire, Thuloghimire, Udipur
	Chiti	Gairagaun(Bhoteni), Seraphantbesi, Bajarkhutta, Khutta Bazar, Devistha
	Bhoteoodar	Gairi, Ramdi, Bhaite Puchhartar, Akalamuni, Belghari, Bhoteodar, Bhakti Chwok
Tanahu		
Gorkha		
Chitwan		

The Marsyangdi Corridor consists of 2 subprojects:

1) Manang-Khudi-Marki Chowk-Bharatpur (MKMB) 220kV transmission line. The transmission line will route from the eastern part of the ACA for about 25 km from Dharapani to Khudi, and then 110 km to Bharatpur of Chitwan District.
2) Associated 220kV Substations at Dharapani, Khudi, Marki Chowk and Bharatpur.

4.1.3 Marsyangdi (Marki Chowk) to Kathmandu

The Project area of Markichowk-Kathmandu (M-K) line covers 17 VDCs of five districts. The administrative units traversed by the transmission line are listed in Table 4.3.

Table 4.3: Administrative units traversed by the Marki Chowk - Kathmandu Transmission Line

District Name	VDC Name	Settlements
Tanahu	Abukhaireni	Markichowk Bazaar, Akala
Gorkha	Deurali	Jaikot, Yangkot, Aambote
	Manakamna	Mathillo Gyaja, Jhyamdanda
	Ghyalchok	Siurenitar, Kaltar
Chitwan	Darechok	Tokdam, Gaunda, Kuringtar, villages, Lewatar, Cheresh
Dhading	Jogimara	Thingbang village
	Salang	Majhigaun, Nibuwatar, Majhuwa, Aadhmara Village
	Benighat	Bishaltar
	Kumpur	Luini Danda village
	Kalleri	
	Pida	
	Baireni	
	Goganpani	Biruwatar
	Kewalpur	Sherapakha village, Ragmigaun, Bhujel gaun
	Thakre	Ganeshe Chaur
	Naubise	
Kathmandu	Baad Bhanjyang	
Five Districts	Seventeen VDC's	

4.1.4 Samundratar-Trishuli Transmission Line[21]

A 25.7 km, 132 kV transmission line will be constructed from Archale of Manakamna VDC in Nuwakot District along the right bank of Trishuli River to Samundratar. This component includes the Trishuli 3B Transmission Hub, a 132/33 kV substation located at Archale of Manakamna VDC in Nuwakot District and substation at Samundratar of Nuwakot District. The Samundratar-Trishuli (ST) Transmission covers 11 VDCs of 1 District, as listed in Table 4.4.

Table 4.4: Administrative units traversed by the S-T Transmission Line

District Name	VDC Name	Settlements
Nuwakot	Manakamna	Archale
	Tupche	Dadathok
	Gerkhu	Satbise, Syale, Upallo Gerkhu
	Bageshwari	Gairikharka, Upallogaun, Katunjegaira
	Lachyang	Chhap, Gairigaun
	Narjamandap	Amare
	Kharanitar	Praudanda, Kosgade
	Ralukadevi	
	Thaprek	
	Sundaradevi	Satbise, Bhyangle
	Balkumari	
One District	Eleven VDC's	

[21] As of 19 February 2014 this section is expected to be dropped from the project.

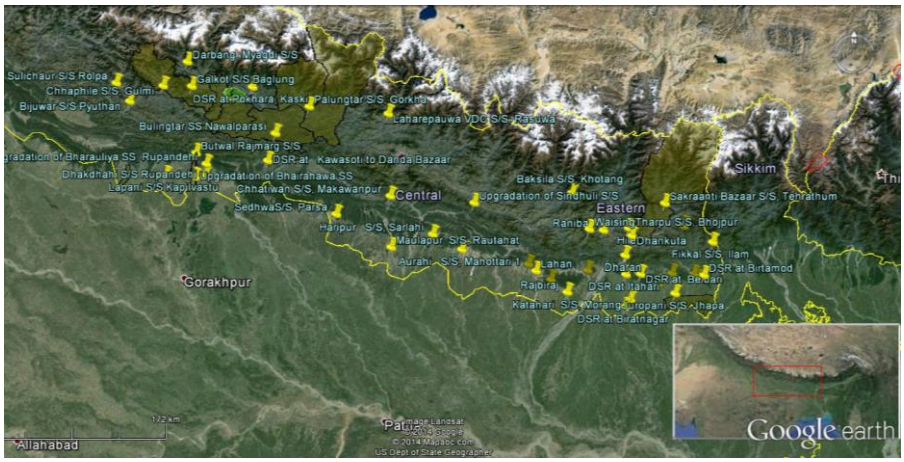
4.1.5 Grid Substation Reinforcement

The following existing grid substations will be upgraded: Gandak 132/33/11kV (30MVA+16.6MVA); Middle Marsyangdi 132/33kV (20MVA); Butwal 132/33 (63MVA); Bharatpur 132/33kv (63MVA); Dhalkebar 132/33kV (63MVA); Lahan 33/11kV (2*16.6MVA); Banepa 66/11kV (2*22.5MVA); Attaria 132/33kV (2*30MVA)The subprojects are for substation upgrade only and will not require land acquisition or major construction. These subprojects are considered to be ADB environment Category C as they involve only new equipment installation at existing substations.

4.1.6 Distribution system augmentation

The subprojects will include village electrification in the transmission corridors, other rural electrification, possibly some distribution system rehabilitation including advanced metering installation, and other demand-side activities such as loss reduction program. These subprojects are considered to be ADB environment Category C or B. Details are to be provided by NEA and will be added to this report when available. The locations are scattered throughout the country as shown in Figure 4.3

Figure 4.3: Location of Distribution Subprojects



4.2 Geography, Geology, and Soils

4.2.1. Kaligandaki Corridor

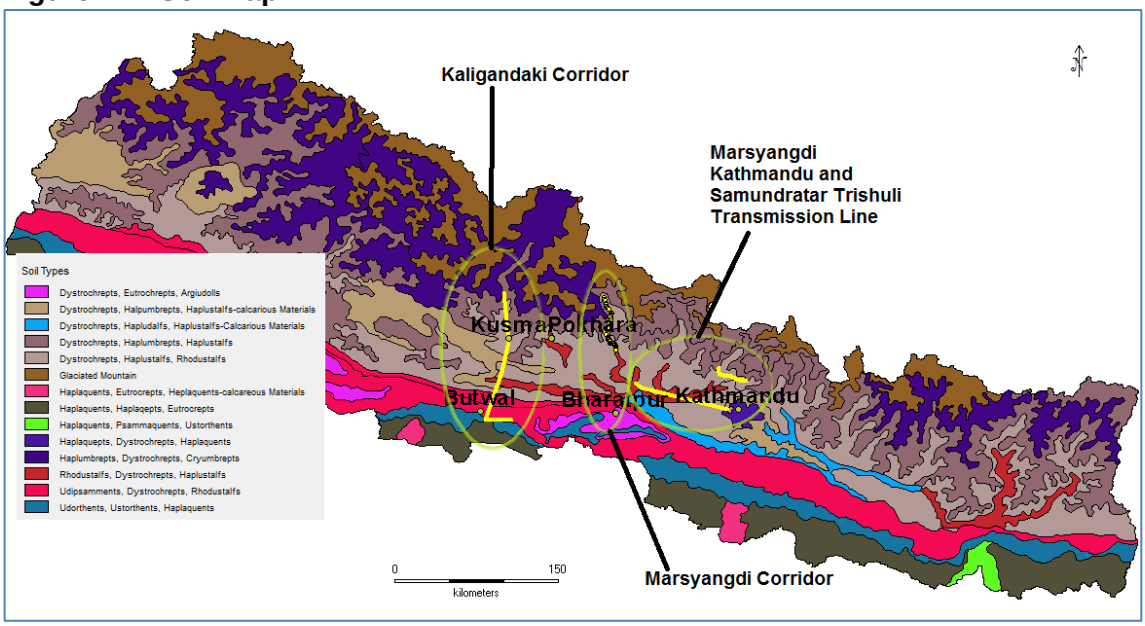
The DKBB tansmission line passes through the following geographic areas with respective portion of total line length: undulating slopes of Middle Mountain 21%, Hills 47%, Siwalik Region 7%, to Terai 25% of Central Nepal. The minimum elevation is 116.6 m in the Pancahnagar VDC of Nawalparasi District. The highest elevation is 1680 m at a ridge line close to Lugrin of Uranpokhara VDC (Parbat District).

The environmental characteristics (topography, soils, water, and air quality) are variable across this broad area. Major soil types along the project site include: Dystrochrepts, Haplumbrepts, Haplustalfs, Rhodustalfs, Haplustalfs-calcarious Materials, Udipsamments, Udorthents, Ustorthents and Haplaquents Materials for M-B Line (Figure 4.4).

The proposed transmission line crosses two tectono-stratigraphic geological zones. The Main Central Thrust that separates the Higher Himalaya in the north with Lesser Himalaya to the south is crossed near Tatopani of Tatopani VDC in Myagdi District. Similarly near Sattawati of Kol Danda VDC in Palpa District it crosses over Main Boundary Thrust that separates Lesser Himalaya to its north and Sub Himalaya to its south.

The Site Geology begins in north with Higher Himalayan Crystallines which consists of Precambrian high grade metamorphic rocks comprising gneisses, quartzites and marbles, while migmatities, and granite gneisses occur in the upper part; about 25 km of the route covers this section. Going southward, a 105 km section crosses over Lesser Himalayan Metasediments initially crossing a 5 km section of the Nawakot Group; these are Precambrian to Lower Paleozoic, mainly shallow marine sediments with lower part dominantly clastic (phyllites, sandstones, quartzites and calcareous sandstones). Stromatolitic limestones and black slates occur in the upper part. The next 40km south of this group forms the Kuncha Group. This Group consists of Precambrian, mainly flyschoid sequence (bedded schists, phyllites and metasandstones), locally shallow water quartzite beds and basic sills and dykes. Further south about 50km zone cross the Nawakot Group again.

Figure 4.4: Soil Map



Source: (ICIMOD)

The next 15km is crosses the Tansen Group, consisting of Permo-Carboniferous to Mid-Miocene clastic sediments with local limestone beds. This group consists of 3 sub series of which the transmission crosses over all. The first to cross over is the Permo-Carboniferous Series. This series composes Permo-Carboniferous, partially glaciomarine and predominantly glaciofluvial and fluvial sediments (diamictities, shales/slates, sandstones and siltstones) with flora and fauna. Secondly, the routing crosses over Mesozoic series which consists of Upper Hurasic to Cretaceous with lower part continental fluvial sediments (conglomerates, sandstones, siltstones and shales/slates. The upper units are partly marine (limestone and shales) dominantly fluvial sediments. The Third Series is the Tertiary Series of Eocene to Mid-Miocene consisting of lower part with marine shales and limestone together with Foraminifera while the upper part consists of sandstones and shales of fluvial floodplain origin havin

plant remains. Finally to its south the transmission line crosses over 15km zone of Siwalik Group and then into the Gangetic Plain. The Siwalik Group is of Middle Miocene to Plio consisting of Pleistocene molassic fluvial deposits, conglomerates, sandstone and shale with vertebrate fossils. While the Gangetic Plain consists of Quaternary Alluvial River Deposists[22].

4.2.2. Marsyangdi Corridor

The proposed transmission line will start from middle mountains in the north and end in inner terai at the south end. The minimum elevation is at Bharatpur 230 masl and the highest elevation it passes through is 1968.5 masl in Dharapani of Manang District. Approximately 25 of the line will cross the ACA from Manang to Khudi.

Major soil types found along the routing includes Dystrochrepts, Haplustalfs, Rhodustalfs, Haplumbrepts, Udipsamments, Eutrochrepts and Argiudolls. Like the K-B Line this north-south corridor too will cross two tectono-stratigraphic geological zones the Main Central Thrust at Tanahu District and Main Boundary Thrust near Bharatpur of Chitwan District.

The site Geology begins in north with Higher Himalayan Crystallines similar to the DKBB Line followed by Lesser Himalayan Metasediments of Nawakot Group.and then the Kuncha Group. Finally at Bharatpur the Siwalik Group is found.

4.2.3. Samundratar-Trishuli Corridor

The proposed transmission line will start from middle mountains in the northwest and end Hills in the southeast. The minimum elevation is near Betrawati Bazaar 610 masl on the bank of Trishuli River and the highest elevation it passes through along the mountain ridge between AP 19 to AP 26 at 1522 masl in Bageshwari VDC.

Major soil types found along the routing includes Dystrochrepts, Haplumbrepts, Haplustalfs and Rhodustalfs. The site Geology begins in northwest with Kuncha Group of the Lesser Himalayan Metasediments followed by Nawakot Group.and then the Higher Himalayan Crystallines.

4.2.4 Seismology

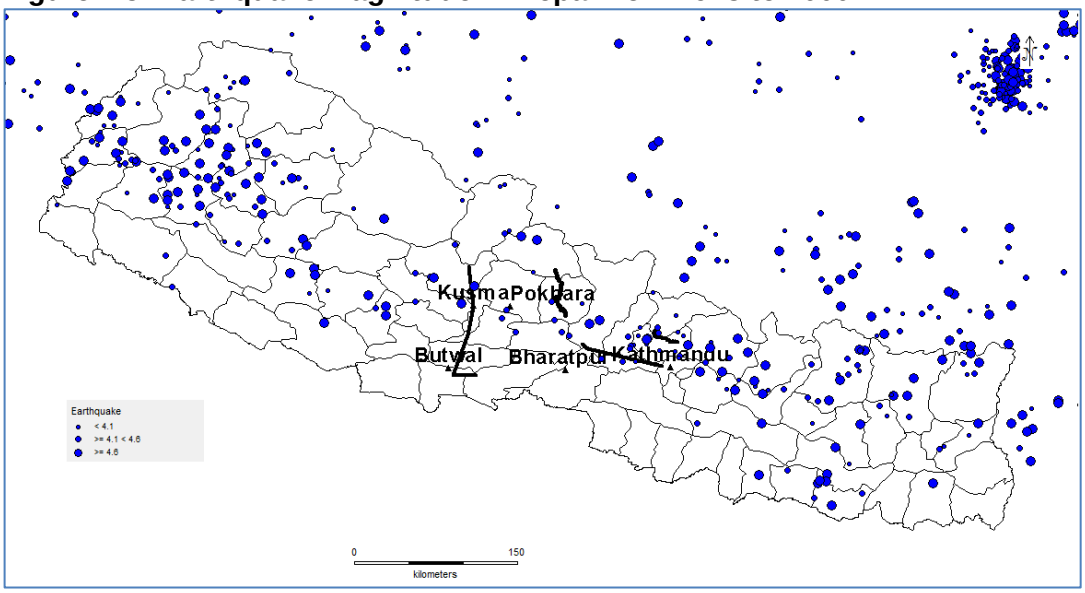
All of Nepal is seismically caused by subduction of Indian tectonic plate under the Tibetan Plate. According to National Seismological Center of Nepal several big earthquakes have been felt in Nepal including the Assam Great Earthquake in 1897, the Kangra Earthquake in 1905, the Bihar-Nepal Earthquake in 1934 and the 1950 Assam Earthquake in 1950, all causing loss of human life and infrastructure. The most recent earthquake with epicenter in central Nepal in the past one year was at Baglung (Richter magnitude 4.1)[23]. West of 85^{o}E longitude, no major earthquakes in Nepal have been observed in the past 500 years. Seismic activity in Nepal between 1973 and 2000 is shown in Figure 4.5.

The Peak Horizontal Acceleration at bed rock that has 10% probability of exceedence over 50 years for three different corridors varies from 100 to 300 gals (0.1 to 0.3 g). For the DKKB Line at the Dana Substation area it is 300gals (0.3 g) which decreases to 200 gals (0.2 g) when reaching Kushma Substation and drops down to 100 gals (0.1 g) at the Bardhaghat Substation area. Similarly, for MKMB line the highest value of 300 gals is observed at Khudi VDC with minimum of 150 gals being observed at Bharatpur. For the M-K Line the highest value of 300gals is observed at Gorkha District with the lowest value of 200 gals observed at Kathmandu. Similarly for the S-T Line the highest value of 350 gals is observed in areas close to Samundratar (Figure 4.6).

[22] HMG, 1993
[23] National Seismological Center, 2013

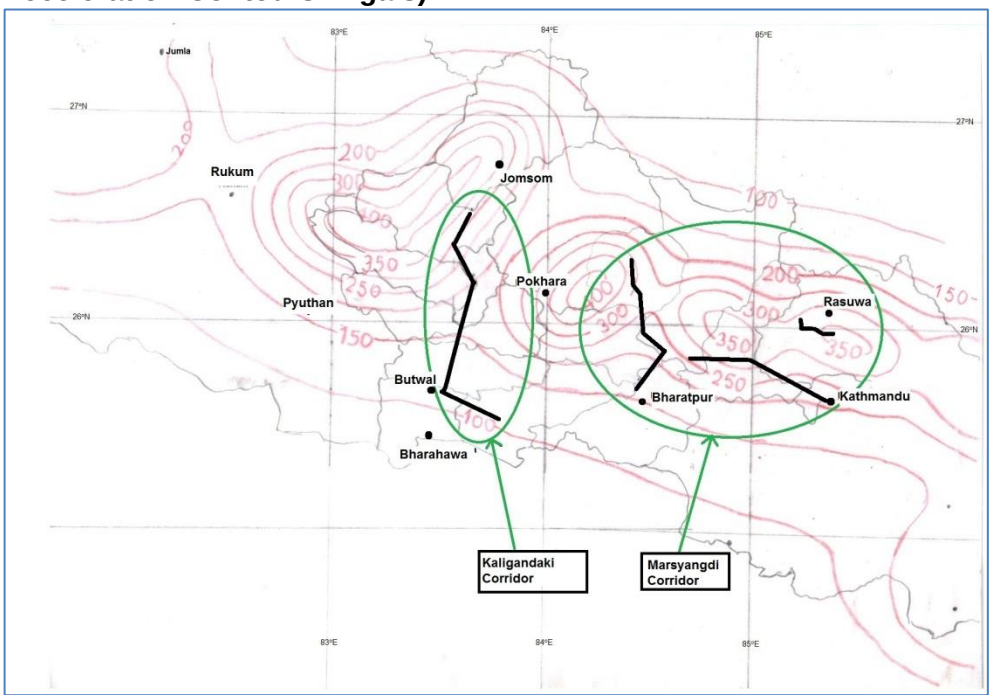
The seismic activity and related risks are well-documented. Project facilities will be designed in accordance with good engineering practice for seismic stability.

Figure 4.5: Earthquake Magnitude in Nepal from 1973 to 2000



Source: (ICIMOD)

Figure 4.6: Seismic Hazard Map of Project Area (Bedrock Peak Ground Acceleration Contours in gals)



Source: National Seismological Centre, Department of Mines and Geology, Government of Nepal

4.3 Climatic and Meteorological Conditions

Meteorological data analysis is considered by using New_LoClim Local Climate Estimator, FAO[24]. Sheperds Method is used for result from FAO Database of nearest 11 stations from desired meteorological stations/location of the transmission line are various points. The various meteorological stations do not all record the same parameters, e.g., at some stations wind parameters are not recorded, and hence the wind data from the next closest station with wind data is utilized.

4.3.1 Kaligandaki Corridor

Climatic conditions prevalent along the alignment vary from Warm Temperate with dry winter and hot summer in areas of Dana Substation, Kusma Substation falling under the Koppen Class Cwa however as the routing crosses over the Siwalik Hills to Butwal the Climatic conditions change to Aw (Equatorial Climate Savannah with dry winter)[25]. Best estimate of average annual rainfall amounts to 2943.04mm of which 91% falls mainly from May to October with slandered error and bias of 77.27 and -3.10. The annual average temperature ranges from below 17.5^{0}C in January to 26.6^{0}C in May[26] (see Figure 4.7 and Figure 4.8).

[24] FAO, 2006
[25] FAO, 2006
[26] MoFSc, DOSC, 2005

Figure 4.7: Kaligandaki Corridor Monthly Temperature

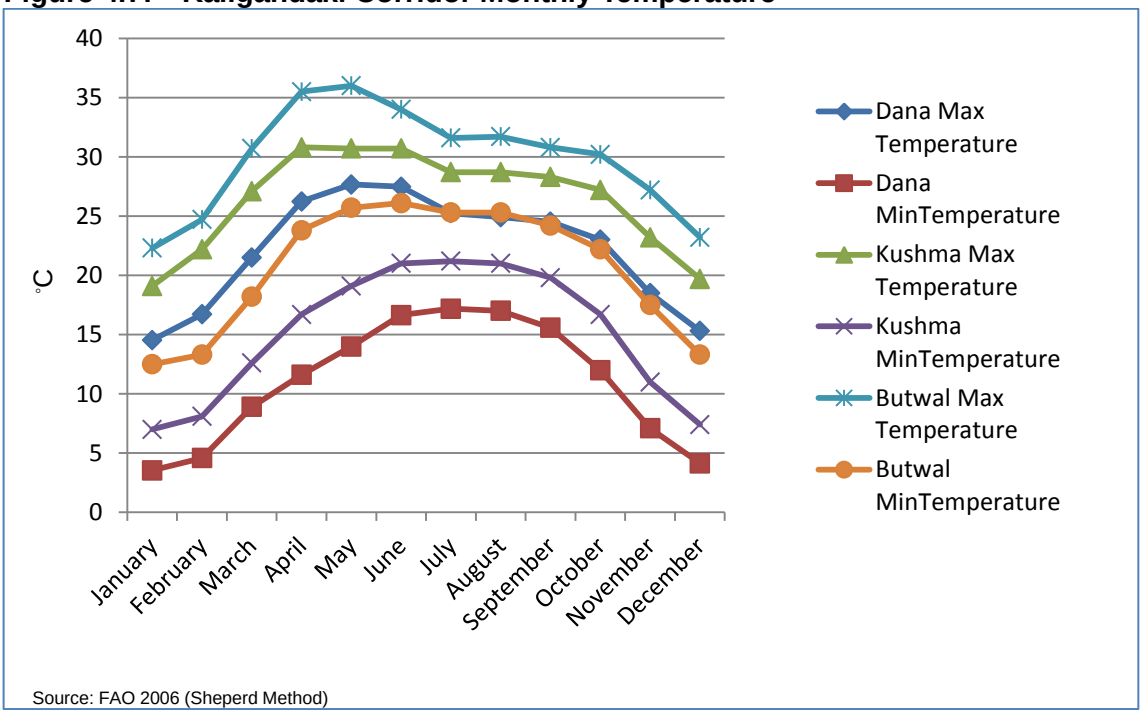
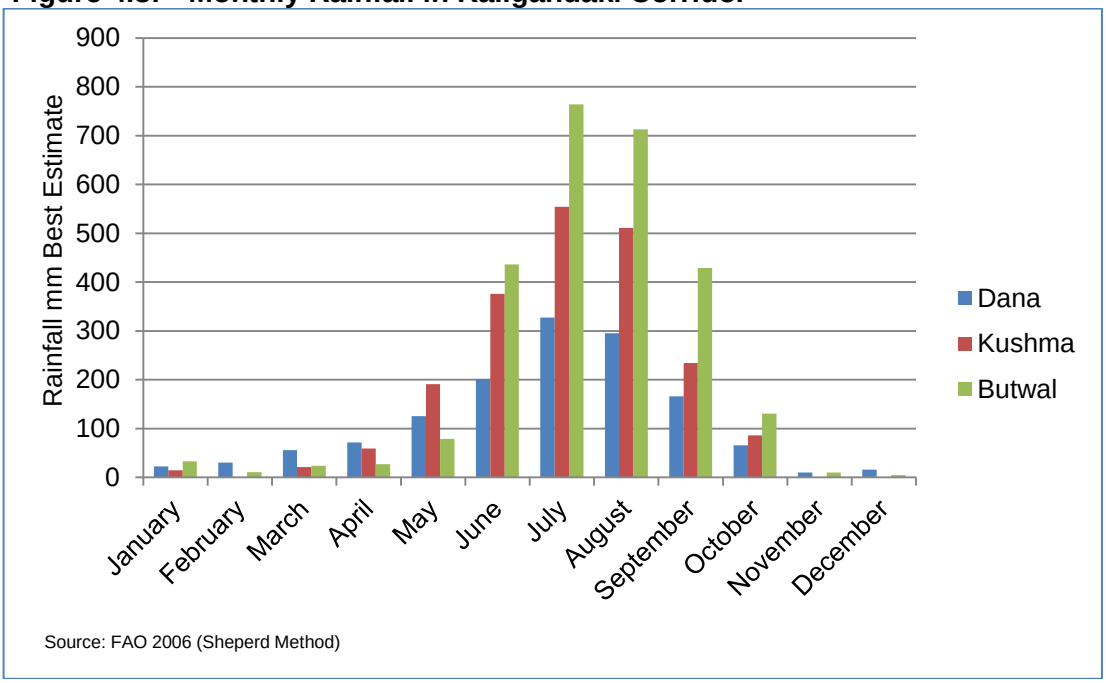


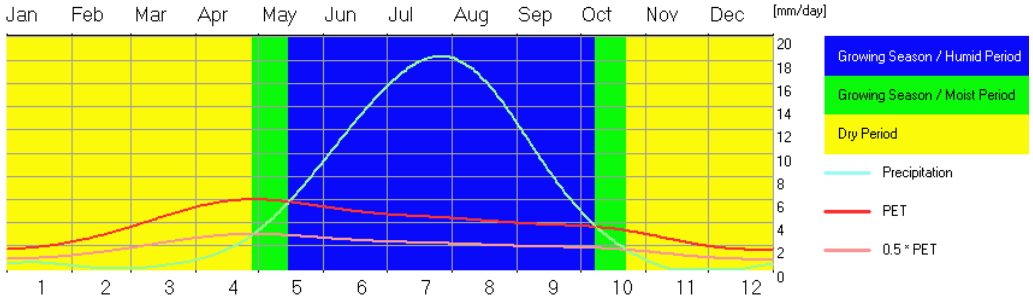
Figure 4.8: Monthly Rainfall in Kaligandaki Corridor



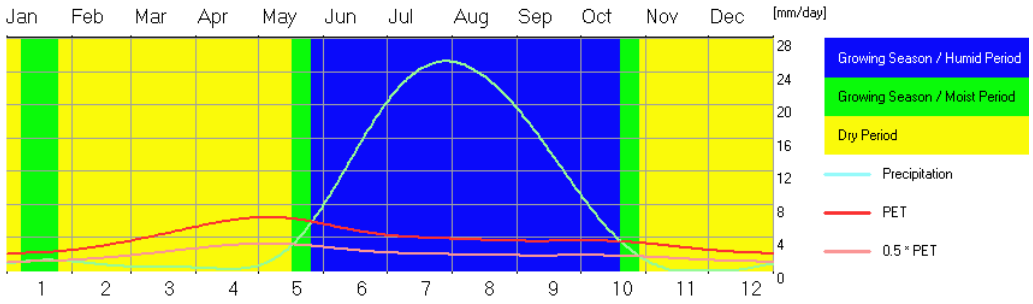
The evaluation of ground frost frequency for Dana varies from a lowest of 1% in March to a highest of 17% in January. Altogether, five months from November to March record frost with highest percentage occurring from December to July. Similarly, for Kushma three months have frost frequency of 3%, 4% and 2% for December, January and February. The runoff based of Budyko's model varies from 435 mm/year, 958 mm/year and 1463 mm/year for Dana, Kushma and Butwal.

The vegetation period analyzed show a single vegetation period for both Dana and Kushma that begins from April 28 and ends in October 22 with climatic net primary production of 1806 g(DM)/m^2/year for Dana and 2229 g(DM)/m^2/year for Kushma (Figure: 4.9). However, there are two vegetation period for Butwal one beginning from January 8 and ending on January 25 while other begins on May 17 and ends on October 28. The climatic net primary production here is 2488 g(DM)/m2/year.

Figure 4.9: Vegetation Period for different stations of DKBB Line



Dana and Kushma



Butwal

Source: (FAO, 2006)

The mean monthly maximum temperature ranges from 22.3°C (at lowest altitude Butwal) to 14.5°C (at highest altitude Tatopani) in January to 36°C to 27.7°C in May, while the mean monthly minimum temperature ranges from 3.54 to 12.5°C in January (Dana) to 17.2 in July to 26.1°C in June (Butwal). The observations show a standard error of 3.02 and 2.39 for maximum and minimum temperature with 0.15 and -0.01 biases respectively. The mean daily sunshine duration in varies from 2.5 to 4 hours in the month of July to 7 to 8 hours in the Month of May[27].

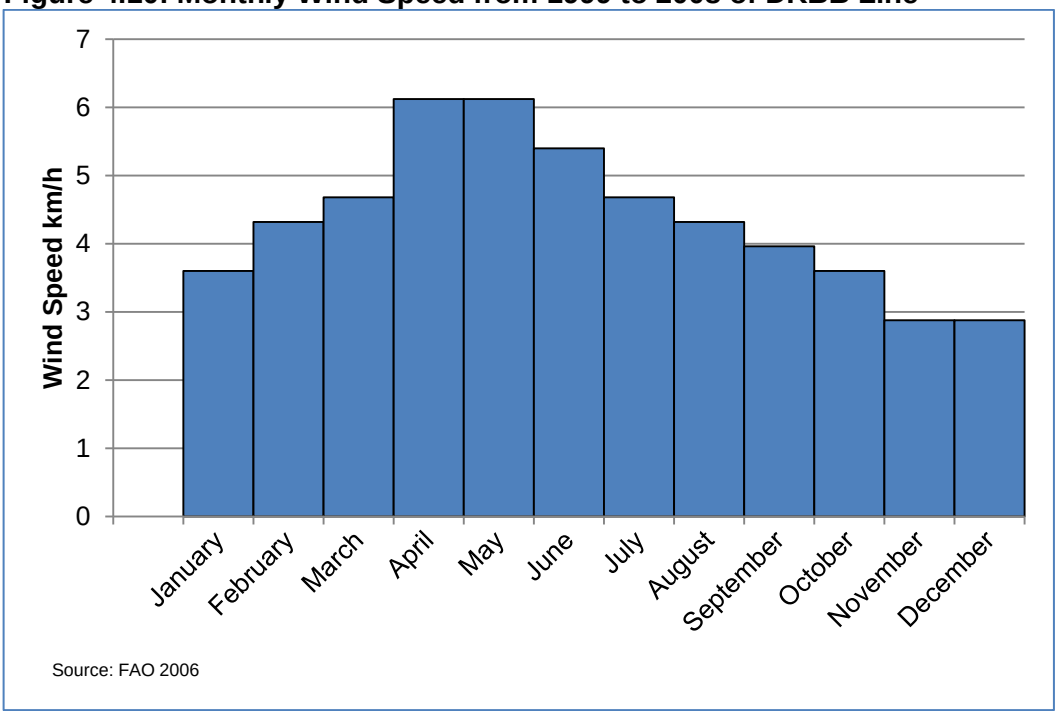
From meteorological data analysis three proposed substation sites along the 155 km length of the transmission line have been taken. Substations site include Dana (1400 masl) from northern end, Kushma (1240 masl) and Butwal (360 masl) in the southern end of the site. Records have been taken for monthly data for wind speed.

The average monthly wind speed for the three stations was observed to be above 3.6

[27] Bajracharya, 1996

km/h from Janary to October and lowest to 2.88 km/h in November and December (Figure 4.10). The estimates had a standard error of 0.01 with a -0.01 bias. It has been observed that highest wind speed is recorded reaching as high as 6.12 km/h in April and May.

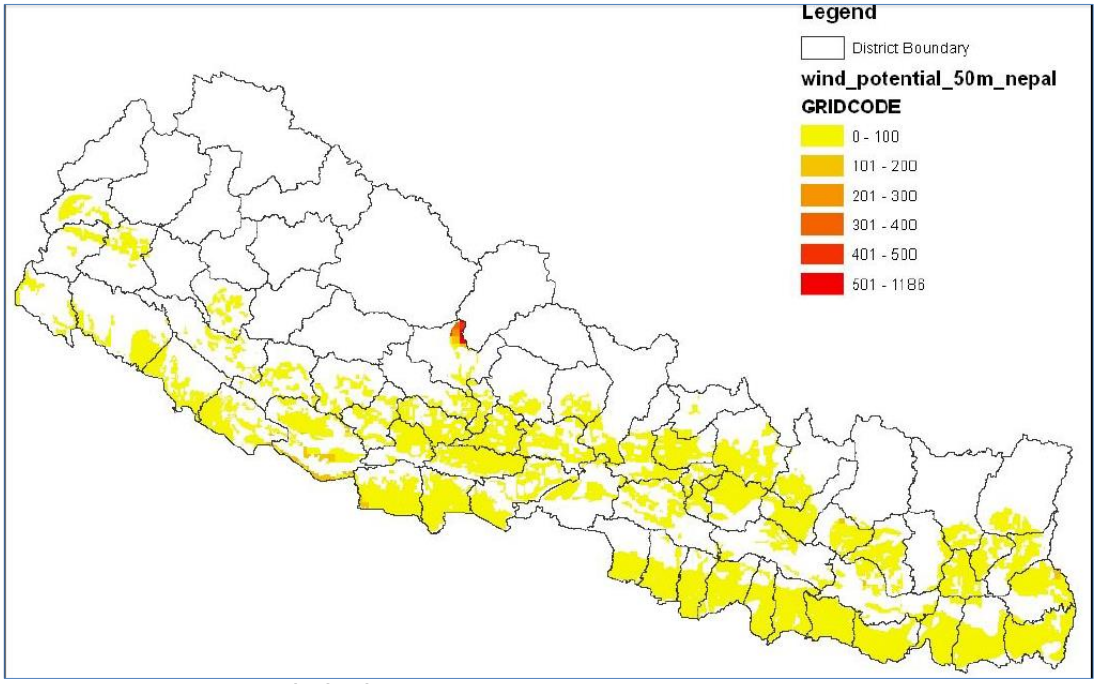
Figure 4.10: Monthly Wind Speed from 1999 to 2008 of DKBB Line



In addition to the above recordings, there are areas with very good wind energy potential close to proposed Dana Substation site in Myagdi District (Figure 4.11)[28]. An area of 97km^2 has been considered as having wind power density (WPD) greater than 300W/m^2 wind energy totaling 489MW in total with 5MW/km^2. The area has been selected within 15km from National Grid, with low population density, with slope less than 45^o and with no forest land.

[28] UNEP, GEF, 2008

Figure 4.11: Wind Power Potential Map of Nepal



Source: SWERA, Nepal Final Report, GIS Part. 2008.

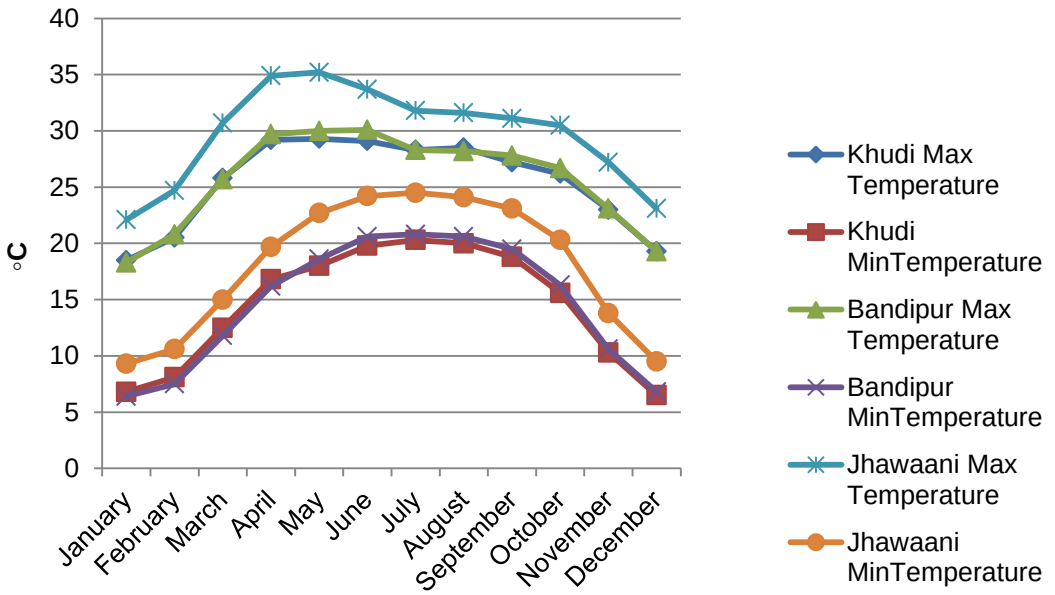
4.3.2 Marsyangdi Corridor

Climatic conditions prevalent along the alignment is Warm Temperate with dry winter and hot summer in areas of Khudi as well as Jhaawani (15km South East of Bharatpur) falling under the Koppen Class Cwa.[29]. Best estimate of average annual rainfall amounts to 2333 mm of which 93% falls mainly from May to October with a standard error of 55.55 and a bias of 15.32. The annual average temperature ranges from below 23.3^0C in January to 12.6^0C in May[30] (see Figure 4.12 and Figure 4.13). The evaluation of ground frost frequency for Khudi varies from a lowest of 2% in February to a highest of 5% in December. Altogether, three months from December to February record frost. Similarly, for Bandipur three months have frost frequency of 4%, 5% and 3% for December, January and February. The runoff based of Budyko's model varies from 2108 mm/year, 837 mm/year and 599 mm/year for Khudi, Bandipur and Jhaawani.

The mean monthly maximum temperature ranges from 22.1°C (at lowest altitude Jhawaani near Bharatpur) to 18.5°C (at highest altitude Khudi) in January to 27.7 to 36°C in May, while the mean monthly minimum temperature ranges from 9.3 to 6.8°C in January to 24.5 to 20.3°C in July at the lowest and highest altitude weather stations respectively. The analysis of above data has a standard error of 2.75 and 2.19 with a bias of -0.27 and -0.13 for maximum and minimum temperatures. The mean daily sunshine duration in varies from 4 to 4.5 hours in the month of July to 7.5 to 9 hours in the Month of May[31].

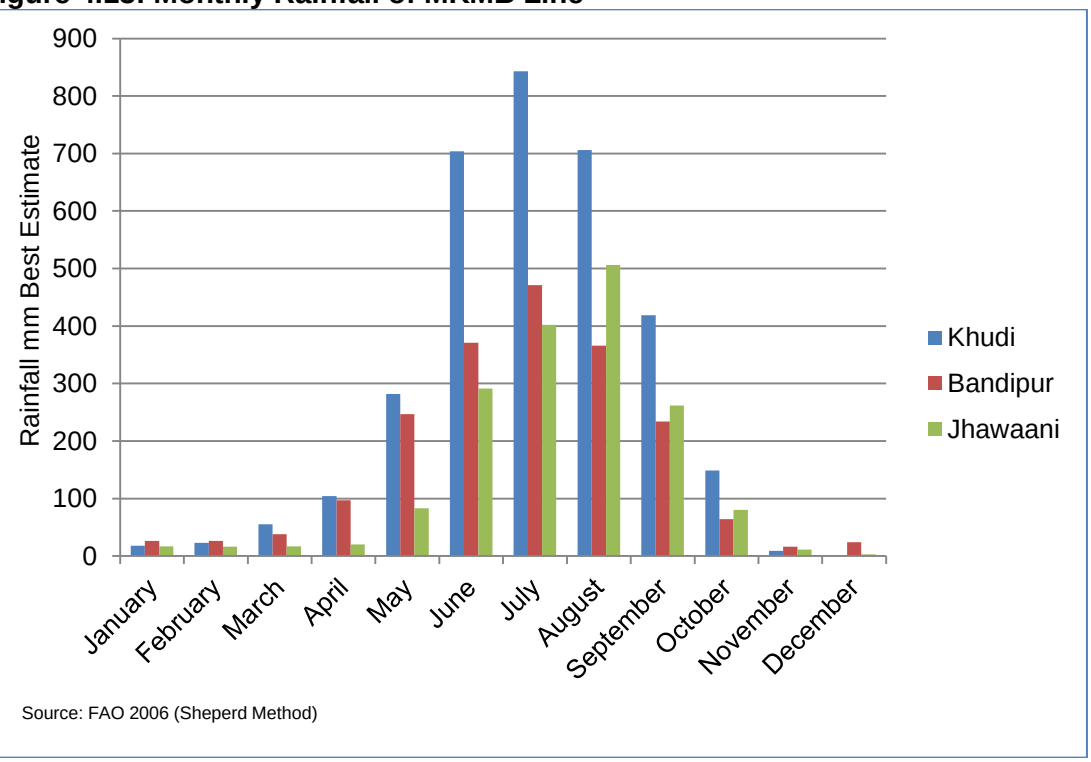
Figure 4.12: Monthly Temperature of MKMB Line

[29] FAO, 2006
[30] MoFSc, DOSC, 2005
[31] Bajracharya, 1996



Source: FAO 2006 (Sheperd Method)

Figure 4.13: Monthly Rainfall of MKMB Line

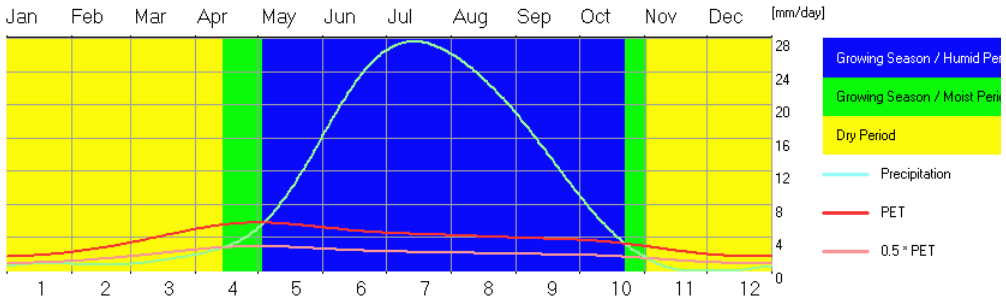


Source: FAO 2006 (Sheperd Method)

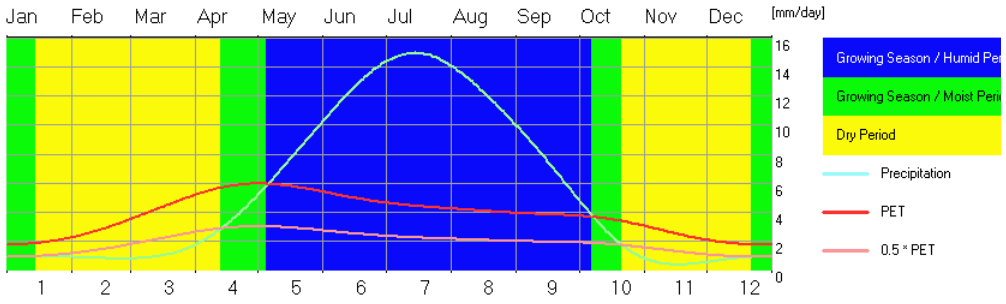
The vegetation period analyzed show a single vegetation period for Khudi and Jhaawani which begins from April 14 and ends in November 1 for Khudi and May 18 to October 22 with climatic net primary production of 2226 g(DM)/m^2/year (gram dry matter (DM) per square meter per year of biological production) and 2035 g(DM)/m^2/year for Khudi and Jhaawani (Figure 4.14). However, there are two vegetation period for Bandipur one beginning from April 13 and ending on October 20 while other begins on December 22 and ends on January 14. The climatic net primary production here is 2194

g(DM)/m^2/year.

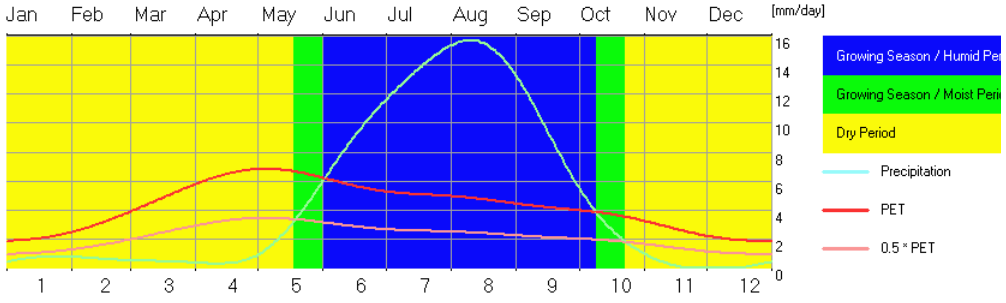
Figure 4.14: Vegetation Period for different stations of MKMB Line



Khudi



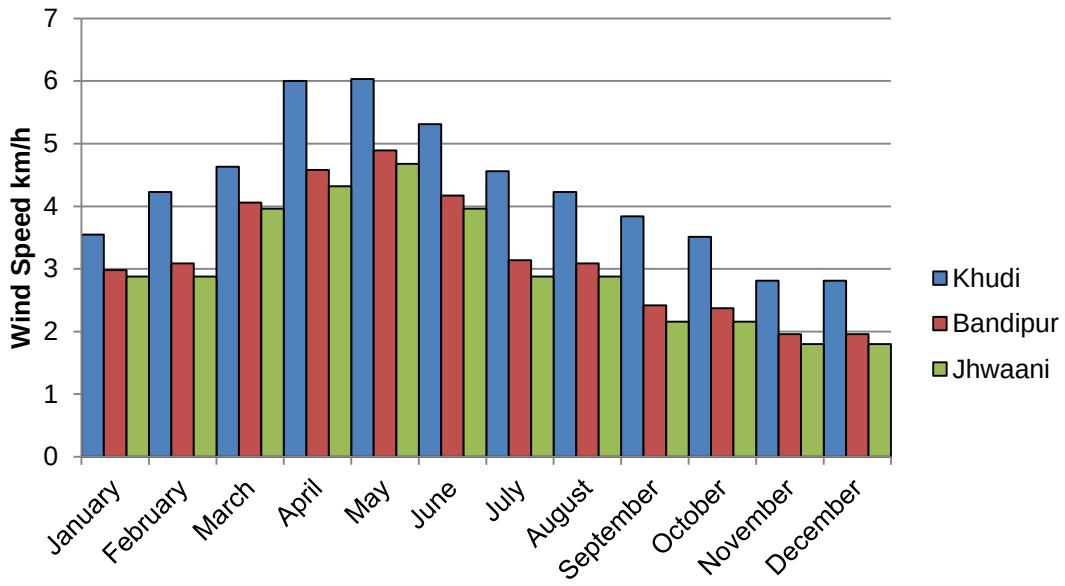
Bandipur



Jhaawani
Source: (FAO, 2006)

The average monthly wind speed for the three stations was observed to be above 3.1 km/h from January to August and lowest to 1.8 km/h in November and December (Figure 4.15). The highest observed wind speed recorded is 6.03 km/h in May. The results calculated have mean standard error of 0.54 with bias of 0.26 for Khudi, 0.67 with bias of 0.13 for Bandipur and 1.35 with bias of -0.06 for Jhwaani.

Figure 4.15: Monthly Wind Speed of MKMB Line



Sourcee: FAO 2006 (Sheperd Method)

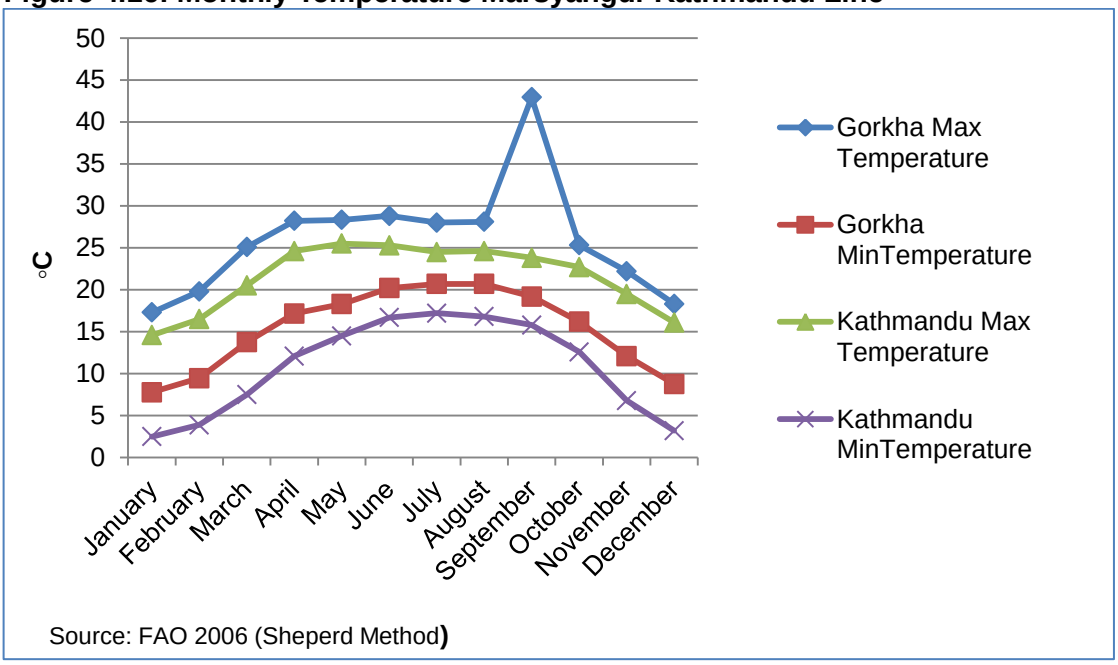
4.3.3 Markichowk-Kathmandu (M-K) Line

The route traverses through areas with Warm Temperate with dry winter and hot summer in areas Gorkha as well as Kathmandu falling under the Koppen Class Cwa.[32]. Average annual rainfall amounts to 1968.9 mm of which 90% falls from May to October. The annual average temperature ranges from below 14^0C in January to 25^0C in May[33] (see Figure 4.16 and Figure 4.17). The evaluation of ground frost frequency for Gorkha varies from a lowest of 1% in December to 2% in January. Altogether, two months December to January record frost. Similarly, for Kathmandu five months have frost frequency of 4%, 19%, 22%, 15% and 3% for November, December, January, February and March. The runoff based of Budyko's model varies from 699 mm/year and 1016 mm/year for Gorkha and Kathmandu.

The vegetation period analyzed show a two vegetation period for both Gorkha and Kathmandu first one begins from April 19 and ends in October 23 for and second period begins from December 20 and ends in January 8 with climatic net primary production of 2099 g(DM)/m^2/year for Gorkha (Figure 4.18). However, for Kathmandu (Thankot Station) vegetation period begins in January 2 and ending on January 7 while other begins on April 17 and ends on October 26. The climatic net primary production here is 1940 g(DM)/m^2/year.

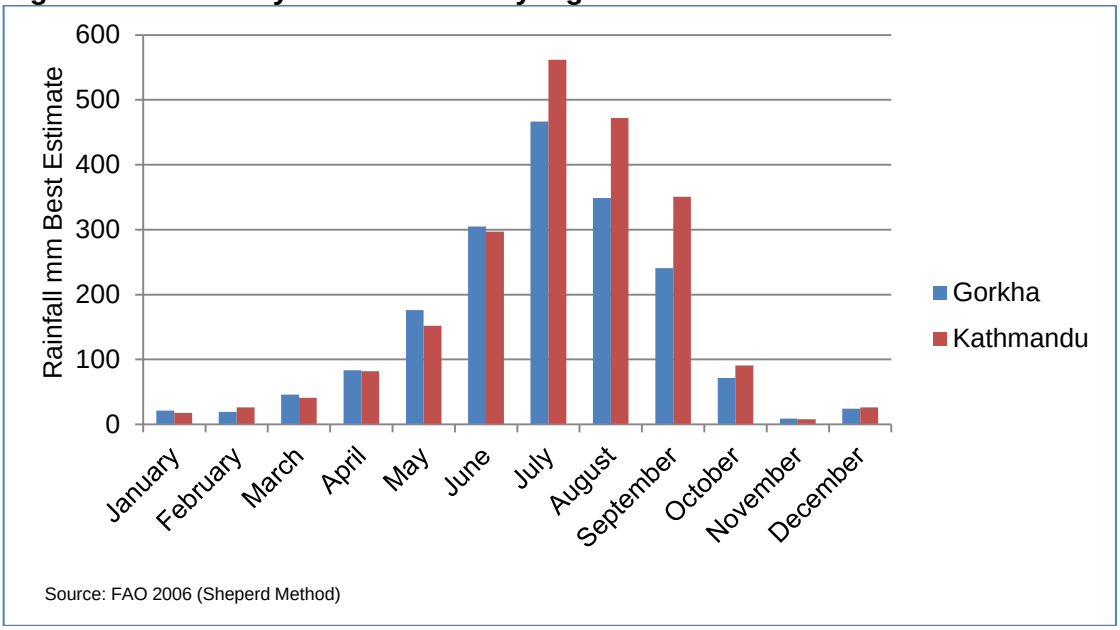
[32] FAO, 2006
[33] MoFSc, DOSC, 2005

Figure 4.16: Monthly Temperature Marsyangdi-Kathmandu Line



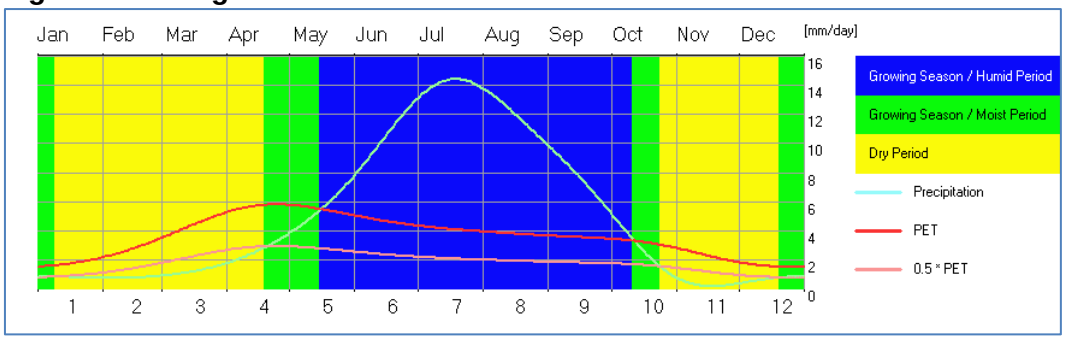
Source: FAO 2006 (Sheperd Method)

Figure 4.17: Monthly Rainfall of Marsyangdi-Kathmandu Line

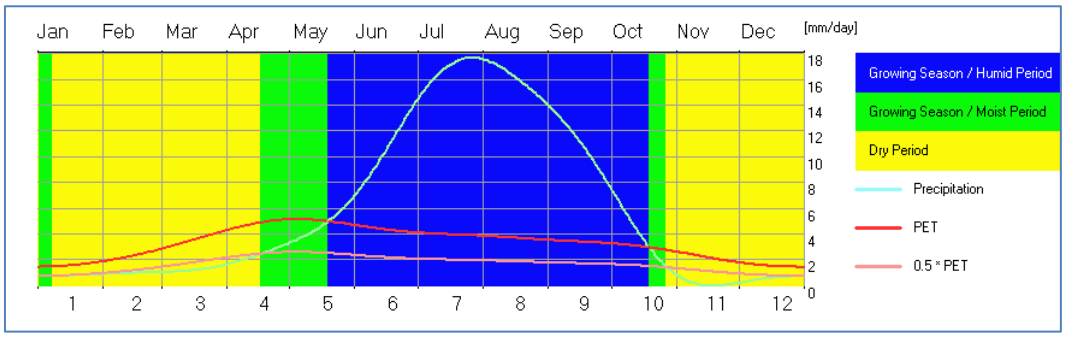


Source: FAO 2006 (Sheperd Method)

Figure 4.18: Vegetation Period for different stations of M-K Line



Gorkha



Kathmandu

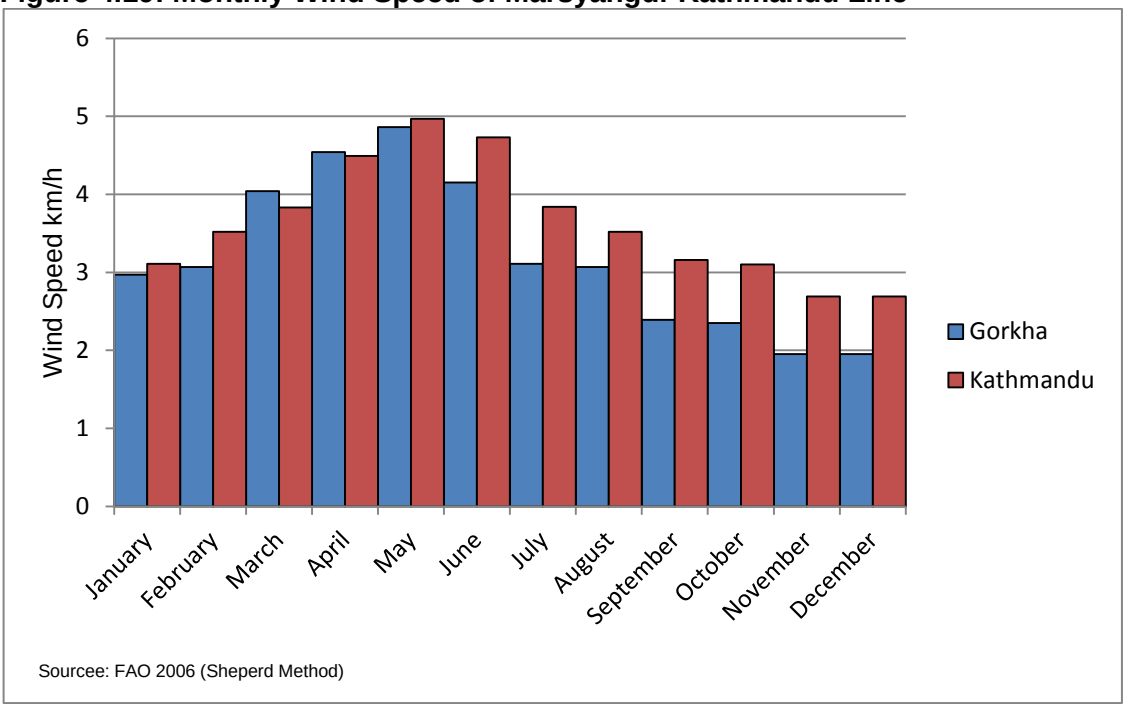
Source: (FAO, 2006)

The mean monthly maximum temperature ranges from 17.31°C (at Gorkha) to 14.6°C (at Thankot near Kathmandu) in January to 28.3°C to 25.5°C in May, while the Mean Monthly Minimum Temperature ranges from 2.5 to 7.8°C in January to 20.69 to 17.2°C in July at western and eastern parts of the transmission line. However, the mean monthly temperature based on FAO's database indicates an abnormal recording of 43^0C in September for Gorkha. The mean daily sunshine duration varies from <2 to 3.5 hours in the month of July to 7 to 8 hours in the Month of May[34].

The average monthly wind speed for the two locations was observed to be above 2.9 km/h from January to August and lowest to 1.95 km/h in November and December for Gorkha (Figure 4.19). The highest wind speed recorded was 4.97 km/h in May in Kathmandu. The results calculated have mean standard error of 1.12 with bias of 0.37 for Gorkha, 1.13 with bias of -0.15 for Kathmandu.

[34] Bajracharya, 1996

Figure 4.19: Monthly Wind Speed of Marsyangdi-Kathmandu Line



4.3.4 Samundratar-Trishuli 3B Hub (S-T) Line

The routing of this component of the project traverses through areas with Warm Temperate with dry winter and warm summer falling under the Koppen Class Cwb.[35]. Average annual rainfall amounts to 1639 mm of which 94% falls from May to October. The annual average temperature ranges from below 16.3^{0}C in January to 26.6^{0}C in May[36] (see Figure 4.20 and Figure 4.21). The evaluation of ground frost frequency for Nuwakot varies from a lowest of 2% in November to 13% in January. Altogether, four months November to February record frost. The runoff based of Budyko's model measures 607 mm/year. The vegetation period analyzed show a single vegetation period which one begins from May 15 and ends in October 18 with climatic net primary production of 1990 g(DM)/m^2/year (Figure 4.22).

The Mean Monthly Maximum temperature ranges from 15.61°C in January to 27.3°C in May, while the Mean Monthly Minimum Temperature ranges from 4.3 in January to 17.7°C in July. The mean daily sunshine duration varies from 2-3 hours in the month of July to 7-8 hours in the Month of May[37].

Figure 4.20: Monthly Temperature Along S-T Line

[35] FAO, 2006
[36] MoFSc, DOSC, 2005
[37] Bajracharya, 1996

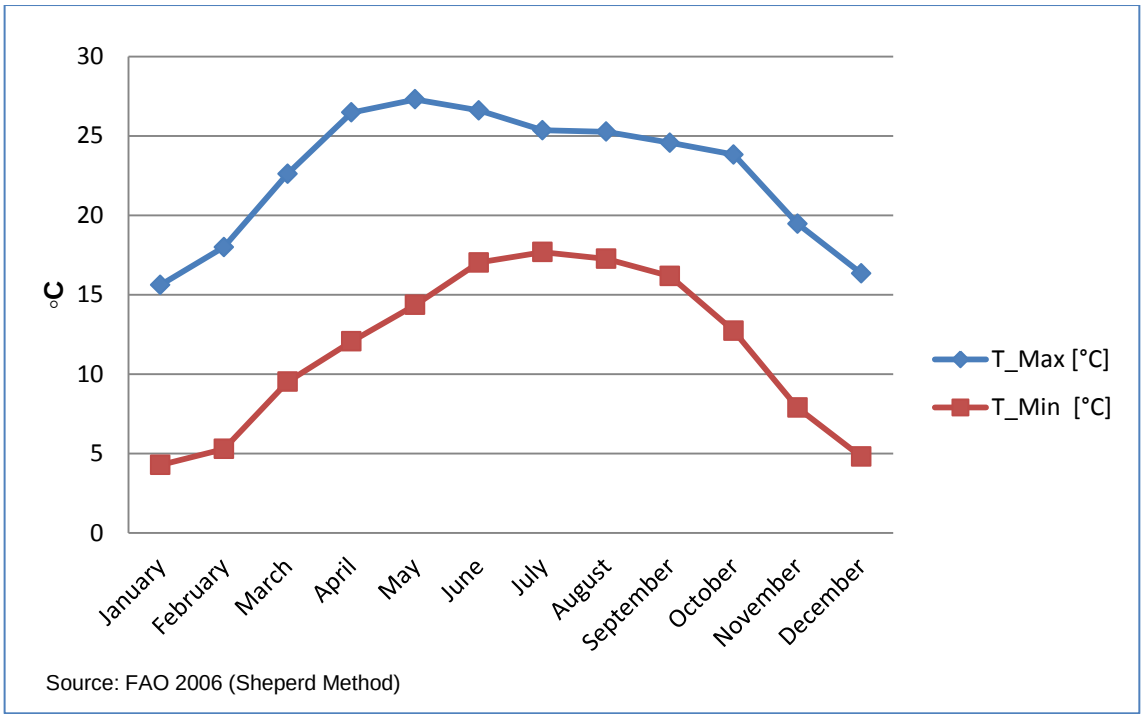


Figure 4.21: Monthly Rainfall of S-T Line

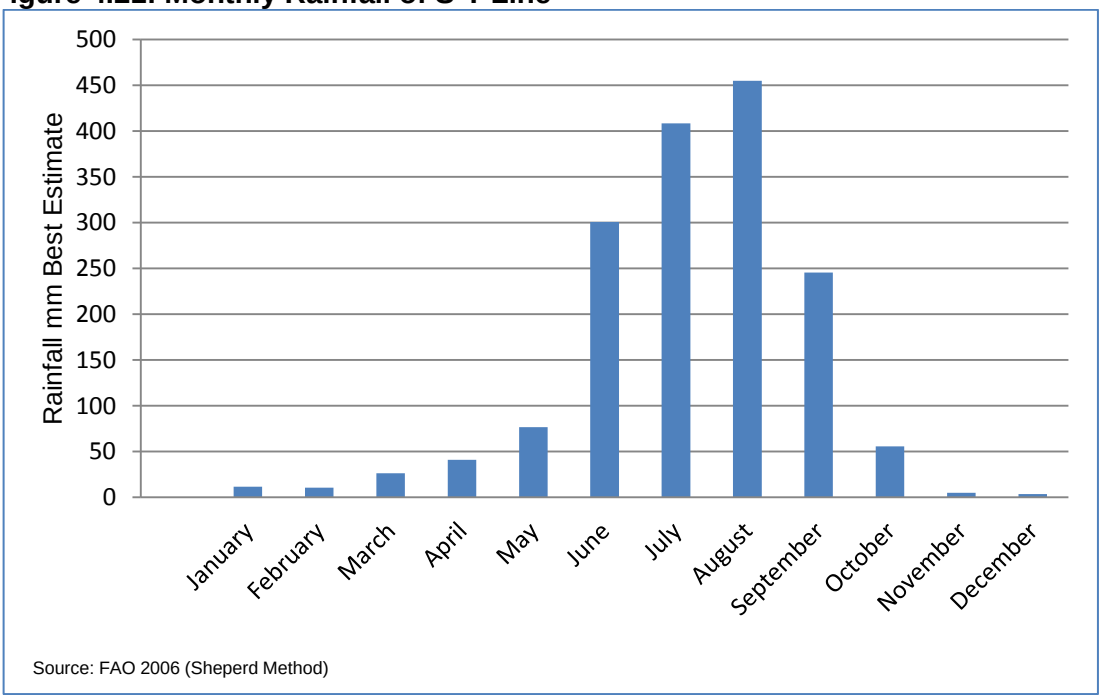
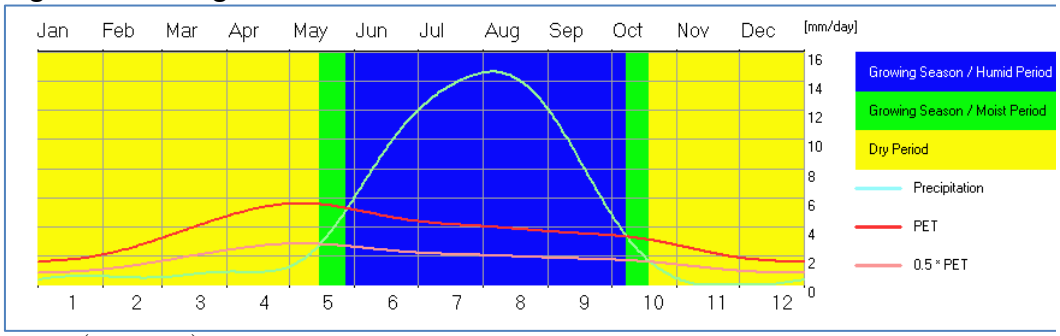


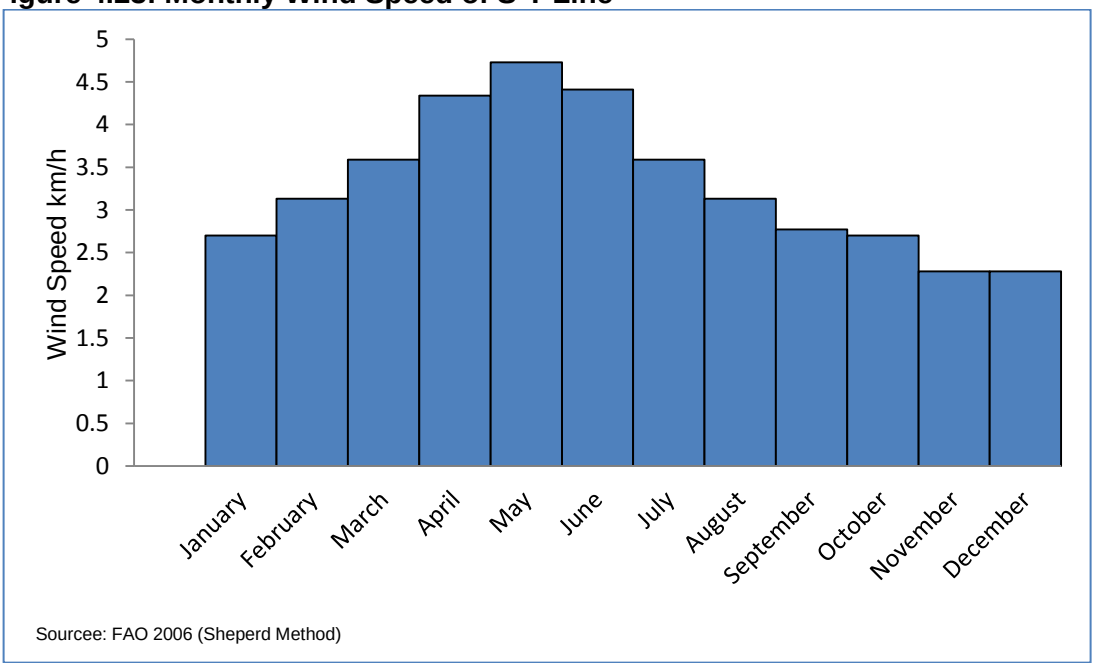
Figure 4.22: Vegetation Period For Different Stations of S-T Line



Source: (FAO, 2006)

Here too the meteorological data is analyzed for best estimate using New_LoClim Local Climate Estimator, FAO. The best estimate of average monthly wind speed for was observed to be above 3.13 km/h from February to August and lowest to 2.7 km/h in October and January (Figure 4.23). It has been observed that highest wind speed is recorded reaching 4.73 km/h in May. The results calculated have mean standard error of 1.13 with bias of -0.15 (Since, only the closest station of Kathmandu was observed to record wind at a distance of approximately 40km it has been included in the data).

Figure 4.23: Monthly Wind Speed of S-T Line



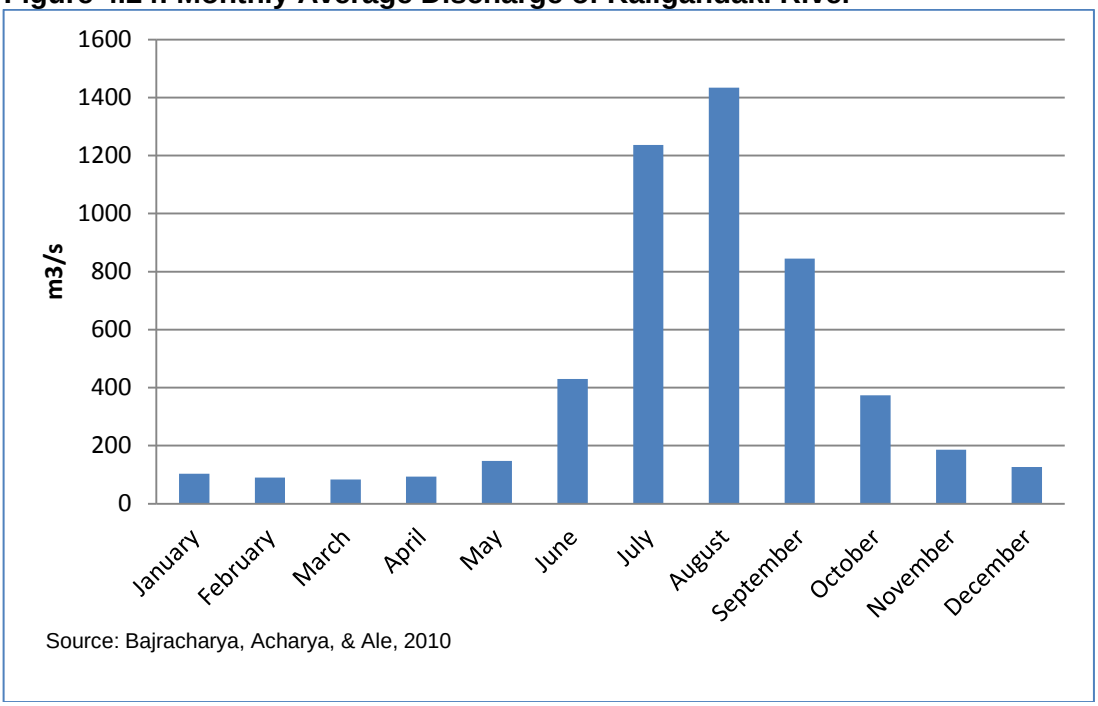
Sourcee: FAO 2006 (Sheperd Method)

4.4 Water Resources

Study from Topographic Sheets and NEA Survey Reports the transmission line has 10 Rivers/Stream crossings between Dana Substation and Kushma Substation. Likewise from Kushma to New Butwal it crosses at 38 places and from New Butwal to Bardhaghat at 13 places[38].

There are three major rivers (Kaligandaki, Marshyangdi and Trishuli) along the project sites. Among them the Kaligandaki is an antecedent drainage river. Maximum Peak Discharge of the major rivers taken from the year 1996 to 2006 for River Kaligandaki at Andhighat Station have been observed to reach a maximum of 2420 m^3/s in August 2008 and minimum of 69.20m^3/s in March 2006. The monthly values of discharge are given in Figure 4.24. The flows of the rivers in Gandaki Basin have been observed to be decreasing and hence will result in decrease in full capacity generation of hydro power plants in the region[39]. This study found annual average flow to be decreasing at 19.82m^3/s/year for Kaligandaki. However, Marshyangdi and Trishuli River has an increase of 0.3149 m^3/s and 2.7366 m^3/s/year respectively. In spite of this both the rivers reveal decreasing dry season discharge of 0.338 and 0.2206 m^3/s/year (November to April). According to Climatic and Hydrological Atlas of Nepal, average drainage density for Myagdi, Parbat, Baglung, Palpa and Syangja is 0.3 to 0.31km/km^2. This is equal to the average drainage density of Nepal which is 0.31. While for Rupandehi and Nawalparasi Districts it is less than 0.3km/km^2.

Figure 4.24: Monthly Average Discharge of Kaligandaki River



Source: Bajracharya, Acharya, & Ale, 2010

Flash Floods

Flash Floods pose great risk to lives and infrastructure close to rivers in Nepal. They can be described as a sudden intense discharge of water with little or no warning which is caused by heavy rainfall, glacier lake outburst event, failure of dam and landslide dammed lake. Among them 24 Glacier Lake Outburst Flood (GLOF) events have been

[38] NEA, 2010
[39] Bajracharya, Acharya, & Ale, 2011

recorded in Nepal which 14 have occurred within the country[40]. Of these events two have been described to have occurred at Kaligandaki River in Mustang region. However, date of occurrence has not been documented. Similarly from 1967 to 1996 twelve major LDOF events have been recorded in Nepal[41]. On 26 September, 1998 a huge landslide occurred on left bank of Kaligandaki near Tatopani Bazaar of Myagdi District. Routing of K-B Line passes close to the river in both these VDCs. The landslide had originated at Goganpani of Shikha VDC and had a length of 1498m and width of 400m depositing large amounts of boulders and sediments in Kaligandaki River (close to AP 45 to AP 46). This event blocked the river for eight hours resulting in the water levels to rise up to 15m and a 500m lake. A total of NRS 5 million worth of damage was reported[42]. The above report mentions following five major causes for the landslide:

(i) Presence of platy minerals like chlorite and mica.
(ii) Steep slope 40-45 degrees
(iii) Thick debris cover
(iv) Excessive Rainfall spread over a long period of time and
(v) Cultivation in the upper mountain slope.

The whole Dana Kushma-Section of the routing falls mostly in areas of High Hazard Class according to Landslide Hazard Zonation Map. These areas have frequent occurrences of active old or dormant landslides with presence of limited stable area for infrastructure development and hence stability measures are must for any type of construction activity[43].

Kaligandaki Basin has 96 Glacial Lakes of which four have been considered to be potentially dangerous[44]. One of these is 119 km upstream from the proposed Dana Substation Site [location code Gka_gl 67 (T)] and a second one is 105.3km upstream from Dana [location code Gka_gl 38 (S)]. Similarly, this report has identified 76 glacial lakes in Marsyangdi Basin of which one is categorized as potentially dangerous: the Thulagi Lake, discussed below.

Thulagi Lake

Thulagi Lake is located at head of the Dona Khola a tributary of Marsyangdi River that joins its left bank in Dharapani at Manang District. The lake is at an altitude of 4044 m and is considered as potentially dangerous glacial lake in Nepal. The lake's area has increased by 18% in the past 15 years. Extreme events as heavy snow fall, rise in temperature and earthquake could trigger a GLOF event at this lake. Modeling studies show that in case of a flood event, areas as far as 95 km downstream in River Marsyangdi will experience a water surge of more than 4 meters, and up to 18m at a distance of 50 km[45]. Khudi VDC will fall approximately 40 km downstream from the Glacial Lake while Dharapani VDC of Manang District is present 13 to 20 km downstream.

[40] Pradeep K Mool, 2011
[41] Shrestha & Bajracharya, 2013
[42] Poudyal, 2002
[43] DMG, 2010
[44] ICIMOD, UNEP RRC.AP, 2002
[45] Pradeep K Mool, 2011

4.5 Biological Resources[46]

Nearly 58% of total length of the DKBB line and all of the other transmission lines are within the Chitwan Annapurna Landscape (CHAL), an area that is critically important for ensuring effective conservation and sustainable livelihood.[47] It represents Eastern Himalayan Alpine Shrub and Meadows, Eastern Himalayan Broadleaf and Conifer Forest, Terai Duar Savannah and Western Himalayan Temperate Forests of the WWF's Global 200 Ecoregions. The routing of DKBB Line crosses over the Western Himalayan Temperate Forests and Himalayan Subtropical Broadleaved Forest only.

The S-T Line crosses over 1.8 km section through Sal, Chir Pine and Chirpine Broad Leaved Forest. Of this, a 350 m section of the transmission line in Gerkhu VDC will cross through very dense Chir Pine Forest[48] with 70% crown cover and according to locals wild animals as leopard, monkeys, pheasants and several other have their habitat. The Chitwan Annapurna Landscape has conservation activities under the Hariyo Ban Program of WWF in partnership with Cooperative for Assistance and Relief Everywhere (CARE), Federation of Community Forestry Users in Nepal (FECOFUN) and National Trust for Nature Conservation through grant from USAID. Some important challenges highlighted with reference to conservation in the Landscape include poaching of wild animals, recurrent forest fires and encroachment of forests. Approximately 15,441 ha of forest have been encroached mainly through illegal occupation[49]. Major animal species conserved here include Snow Leopard, Himalayan Thar, Red Panda, Musk Deer, Himalayan Black Bear and Clouded Leopard in the mountains and Tiger, Gharial, One Horned Rhinoceros in the Terai. Several plant species of medicinal values have been identified in the region.

Furthermore, the area specially closer to the upper area of the Kaligandaki Corridor serves as a corridor for migrating birds between Tibetan Plateau and Gangetic Plains. According to Bird Life International, Central Asian Flyway is an area acquiring an area of 34,089,399 km^2 and 307 species of migratory birds use this route. This route although classified at Continent level (generalization) and is not a strictly followed route a deeper study may be required if there are any Palertic breeders like Bar-headed Goose (*Anser indicus*) crossing over the proposed alignment. There are 2 critically endangered birds, 5 endangered birds, 13 vulnerable and 10 near threatened species that use this flyway[50]. According to Bird Life International, Nepal has 3 Endemic Bird Areas namely Western Himalayan, Central Himalaya and Eastern Himalaya. These areas consists restricted range bird species. Kaligandaki Valley serves as a boundary between Western and Eastern Himalaya where most of the species breed in Temperate Forests.

Five important bird areas (IBA, see criteria below) are in the overall project area of Central-Western Nepal (Figure 4.25). Annapurna Conservation Area (Number 1), Farmlands in Lumbini (Number 14) and Nawalparasi Forest (Number 17) are in the same general area as the Kushma-Butwal Line. Similarly ACA and Bharandabhar Forest (Number 2) and wetlands (Forest areas north of Bharatpur at the Left Bank of Narayani River) are in the same general areas as the M-B Line and Shivapuri-Nagarjun National Park (Number 24) is in the same general area as the M-K Line. Furthermore, approximately 5km section of Marshyangdi Corridor at the northern most section crosses through the Annapurna Conservation Area. Also, if the M-B line routing does

[46] Appendix 1 presents lists of protected flora and fauna and other potentially sensitive species. These are defined by various Nepal regulatory acts and the Convention on International Trade in Endangered Species (CITES).

[47] The Sacred Himalayan Landscape is not a protected area under Nepali environmental regulations.

[48] ICIMOD

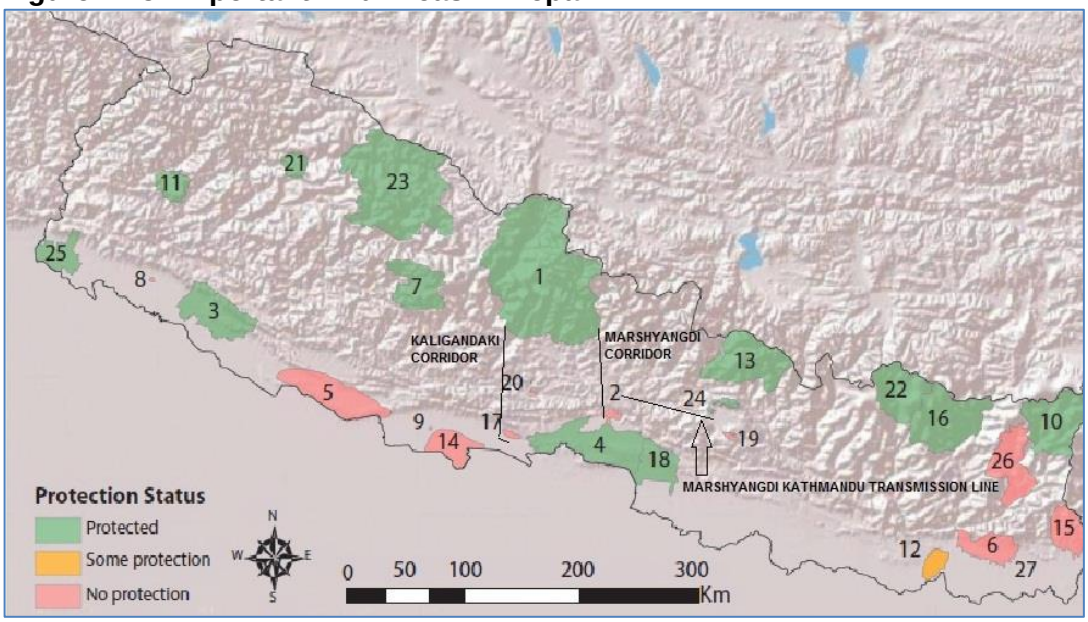
[49] Gautam, et al., 2012

[50] International, 2011

not avoid the northern Forest parts left bank of Narayani River of Bharatpur it will cross through the Bharandabhar Forest and wetlands. IBA is located close to the proposed Kaligandaki alignment between 83°39'1.00 East, 28°32'8.29" North to 83°37'49.11"East, 28°27'50.61"North and 83°37'14.91"East 27°34'55.60"North for Annapurna, Nawalparasi and Chitwan.

There are several wetlands along the route (for instance the transmission line passes close to Sattawati Pond located in middle of forest at 1000 masl in Koldada VDC of Palpa District). Kaligandaki gorge is considered important in terms of biodiversity as it is the boundary between eastern and Western Himalaya. Kaligandaki Valley is a migratory corridor for birds which move south to winter in India. Approximately 40 migrating bird species have been recorded migrating along the valley including Demorselle Crane and 20 raptors. Documentation of large numbers of birds of prey along the Karne/Lumle saddle has been done during autumn and these migrations occur east to west. In another location of Ghorepani over the Deorali pass, 54 Steppe Eagles and 1 Imperial Eagle was recorded migrating east to west in 20 minutes in November 1986[51]. The Ghorepani zone is located at 28° 24' N and 83° 43' E; this area is 12 km East of the Dana-Kushma Section of the DKBB line in VDC's Rakhu Bhagwati, Bagarkhola and Tatopani.

Figure 4.25: Important Bird Areas in Nepal



Source: Bird Conservation Nepal

Furthermore, large number of birds of prey, totaling over 8,000 individuals of 20 species including Greater Spotted Eagle (*Aquila clanga*) has been seen in one season[52]; the study recorded 8 globally threatened, 7 near threatened and 6 restricted range species in the valley. Some important species mentioned is Cheer Phesant (*Catreus wallichi*), Satyr tragopan (*Tragopan satyra*) and Spiny Babbler (*Turdoides nipalensis*). Two locations at the edge of Annapurna Conservation Area are considered as internationally important raptor migration sites that also represent it in the Himalayan Region[53]. The first site is in Khare which lies at the southern boundary of Annapurna Conservation Area. The second site is located at upper reaches of Kaligandaki River in its eastern

[51] Carol & Inskipp, 2003
[52] Baral & Inskipp, 2005
[53] Baral & Inskipp, 2005

bank. A list of bird species found in these IBA is provided in table in Appendix 1, Table 1.

IBA Criteria

The IUCN and IBA criteria as referred from IUCN[54] and Birdlife International[55] websites are explained as follows.

A1. Globally threatened species:

The site qualifies if it is known, estimated or thought to hold a population of a species categorized by the IUCN Red List as Critically Endangered, Endangered or Vulnerable. In general, the regular presence of a Critical or Endangered species, irrespective of population size, at a site may be sufficient for a site to qualify as an IBA. For Vulnerable species, the presence of more than threshold numbers at a site is necessary to trigger selection. Thresholds are set regionally, often on a species by species basis. The site may also qualify if holds more than threshold numbers of other species of global conservation concern in the Near Threatened, Data Deficient and, formerly, in the no-longer recognized Conservation Dependent categories. Again, thresholds are set regionally.

A2. Restricted-range species:

The site is known or thought to hold a significant component of a group of species whose breeding distributions define an Endemic Bird Area (EBA) or Secondary Area (SA). This category is for species of Endemic Bird Areas (EBAs). EBAs are defined as places where two or more species of restricted range, i.e. with world distributions of less than 50,000 km^2, occur together. More than 70% of such species are also globally threatened. Also included here are species of Secondary Areas. A Secondary Area (SA) supports one or more restricted-range species, but does not qualify as an EBA because less than two species are entirely confined to it. Typical SAs include single restricted-range species which do not overlap in distribution with any other such species, and places where there are widely disjunct records of one or more restricted-range species, which are clearly geographically separate from any of the EBAs.

A3. Biome-restricted species:

the site is known or thought to hold a significant component of the group of species whose distributions are largely or wholly confined to one biome.

A4. Congregations Site:

The site is thought to hold on a regular basis 1% of a biogeographic population of a congregatory water bird species or/and 1% of global population of congregatory seabird or terrestrial species and/or 20,000 water birds or 10,000 pairs of seabirds of one or more species and/or site known or thought to exceed thresholds set for migratory species at bottleneck sites.

54 http://jr.iucnredlist.org/documents/redlist_cats_crit_en.pdf

55 http://www.birdlife.org/datazone/info/ibacritglob

IUCN Categories

Critically Endangered means a taxon is facing extremely high risk of extinction in the wild, and meet any of the following criteria A to E. Criteria A denote reduction in population greater than or equal to 80% if three generation or 10 years. Similarly Criteria B denotes in form of either extent of area or area of occupancy or both where the extent of area being less than 100km^2 and area of occupancy being less than 10km^2. The criteria C denote population size estimated to be less than 250 mature individuals. Criteria D indicates population size estimated to number fewer than 50 mature individuals. Criteria E means Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer.

Endangered species means when the best available evidence indicates that it is considered to be facing high risk of extinction meets any of the following criteria A to E. Criteria A denote a reduction in population size of greater than or equal to 50 or 70% in 10 years of three generations. Criteria B means geographic range in the form of extent of occurrence or area of occupancy or both where extent of occurrence being less than 5,000km^2 and are of occupancy being less than 500km^2. Criteria C indicates population size estimated to number fewer than 2,500 mature individuals. Criteria D qualifies for population size estimated to number fewer than 250 mature individuals. Criteria E means quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer.

Vulnerable species means when the best available evidence indicates that it is considered to be facing high risk of extinction and meets any of the following criteria A to E. Criteria A denote a reduction in population size of greater than or equal to 50 or 30% in 10 years of three generations. Criteria B means geographic range in the form of extent of occurrence or area of occupancy or both where extent of occurrence being less than 20,000km^2 and are of occupancy being less than 2,000km^2. Criteria C indicates population size estimated to number fewer than 10,000 mature individuals. Criteria D qualifies for population size estimated to number fewer than 1,000 mature individuals with restricted area of occupancy typically less than 20km^2. Criteria E means quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

Among all these species of birds it has been found that bustards, cranes and raptors (Accipitridae) have small binocular fields with large blind areas are vulnerable to collisions with power lines[56]. The collision of birds with power lines is mostly associated with shield wires because these are the highest wire on a tower and are smaller in diameter than individual phase conductors making them difficult to see[57]. The reason of susceptibility is functions of species characteristics as body size, weight, wing shape, flight behavior and nesting habits. In general birds of prey are good fliers, have the ability to avoid obstacles, and are not prone to collisions. However, when they are engaged in activities such as territorial defense and pursuing prey the collision risk increases. Several means with different rate of success have been observed with marking devices that tend to increase visibility. These include aviation marker balls, spiral vibration dampers, air flow spoilers, bird flight diverters of various designs and dimension, and several devices that have movement, such as swinging plates or flappers. However, several issues as added weight of ice and snow at high altitudes, adverse actions of wind, and corona discharge also need to be taken into account while placing such devices[58].

[56] Martin & Shaw, 2010

[57] Avian Power Line Interaction Committee (APLIC), 2012

[58] Bridges, Theodore, Shulund, Linda , & Tim , 2008

The New Butwal to Bardhaghat Section that lies close to two IBAs “Farmlands in Lumbini Area” and “Nawalparasi Forest” a Vulture Safe Feeding Site is located 25km south west of New Butwal Substation site where birds as Saras Crane and seven of eight vulture species have been recorded. These include migratory species as Cinereous Vulture, Himalayan Vultures and Eurasian Griffons[59]. Similarly at the Nawalparasi that is 3 km north of the transmission line and Bardhaghat Substation White-rumped Vulture (*Gyps bengalensis*) a resident species 71 nests in 2002-2003 have been recorded for White Rumped Vulture[60].

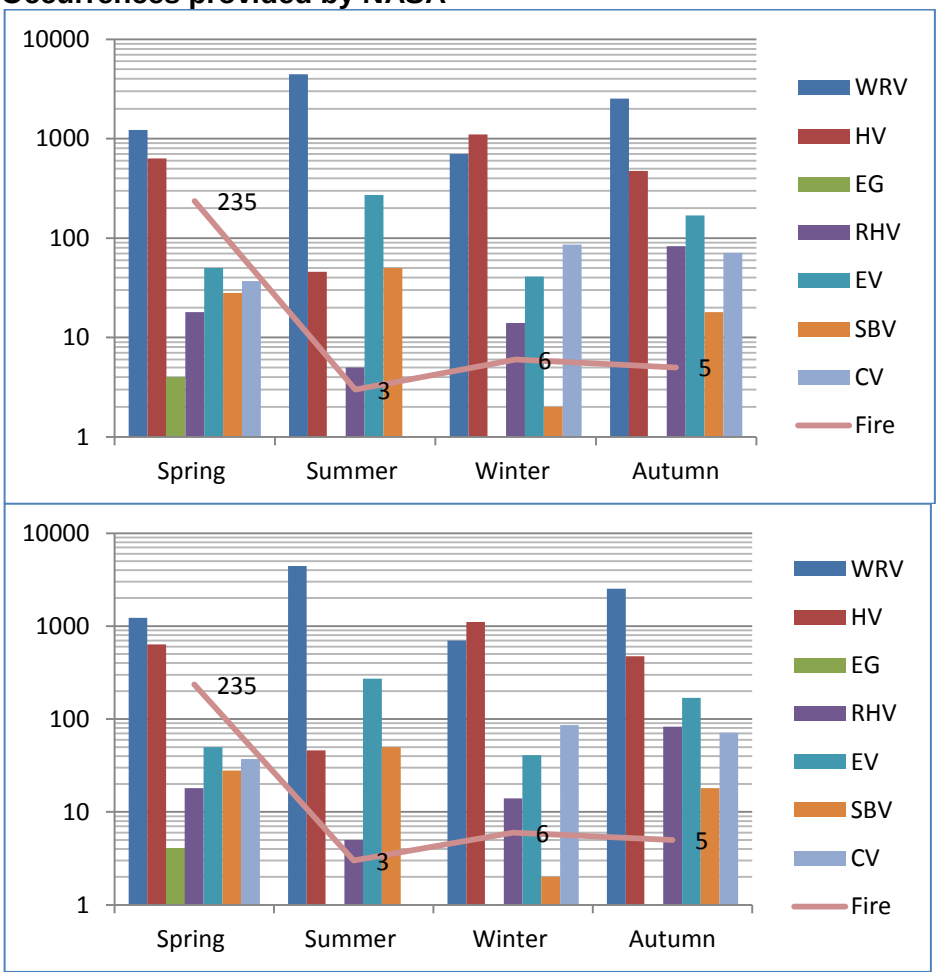
Based on observation of fire occurrences in areas close to these IBA sites it can be noted that most occurs in the spring season when largest number of species were recorded including large numbers of migratory birds (Figure 4.26).

The observation of birds at the Vulture Safe Feeding Site of Rupandehi have been used from data of Ibisbill Journal of Himalayan Ornithology 2013 and compared with fire occurrence data between January 2012 and July 2013 provided by NASA. It can be observed that greatest number of fire occurrences is concentrated at Siwalik Region immediately north of these two IBA which is mostly confined in forests and also when the season when the largest number of species is recorded coincides. The RoW of transmission line will also aid in preventing spread of forest fire.

In another study conducted for a resident vulture Lammergeier (*Gypaetus barbatus*) (habitat range 1200 to 4100masl) from Muktinath to Beni along the Kaligandaki Valley including sections of the DKBB line, lowest numbers were observed in Dana[61], while highest numbers were observed in Upper Mustang and Lower Mustang areas which are upstream and beyond the project sites. This study mentions several factors as less suitable nesting site, less rocky areas and unavailability of food as possible major causes for reduced numbers downstream. Therefore, more information on possible measures to increase visibility of the transmission line and hence reduce mechanical accidents in certain sections will be an advantage. In addition to habitat suitability studies done on bird distribution in ACA suggest Lower and Upper Temperate zone (2000 to 3800 masl more species rich)[62] yet good number of species have been observed in Subtropical Zone (1000-2000 masl) in Ghasa and Gorepani (areas closer to Bhurung Tatopani, Ghar, Histan Mandali and Sikha). The transmission routing is all at elevations below the temperate zone, but is generally within the Subtropical Zone elevation range (as shown in Figure 4.1 and 4.2 above).

[59] Dhakal, Sharma, & Chaudhary, 2013
[60] Baral & Inskipp, 2005
[61] Giri, 2013
[62] Carol & Inskipp, 2003

Figure 4.26: Seasonal Variation in Vultures at Rupandehi VSFS and Fire Occurrences provided by NASA



Comparisons between (Dhakal, Sharma, & Chaudhary, 2013) and (Maryland, 2002) data

WRV: White Rumped Vulture, HV: Himalayan Vulture (Migratory), EG: Eurasian Griffons (Migratory), RHV: Red Headed Vulture, EV: Egyptian Vultures, SBV: Slender-billed Vultures, CV: Cinereous Vultures. (Migratory)

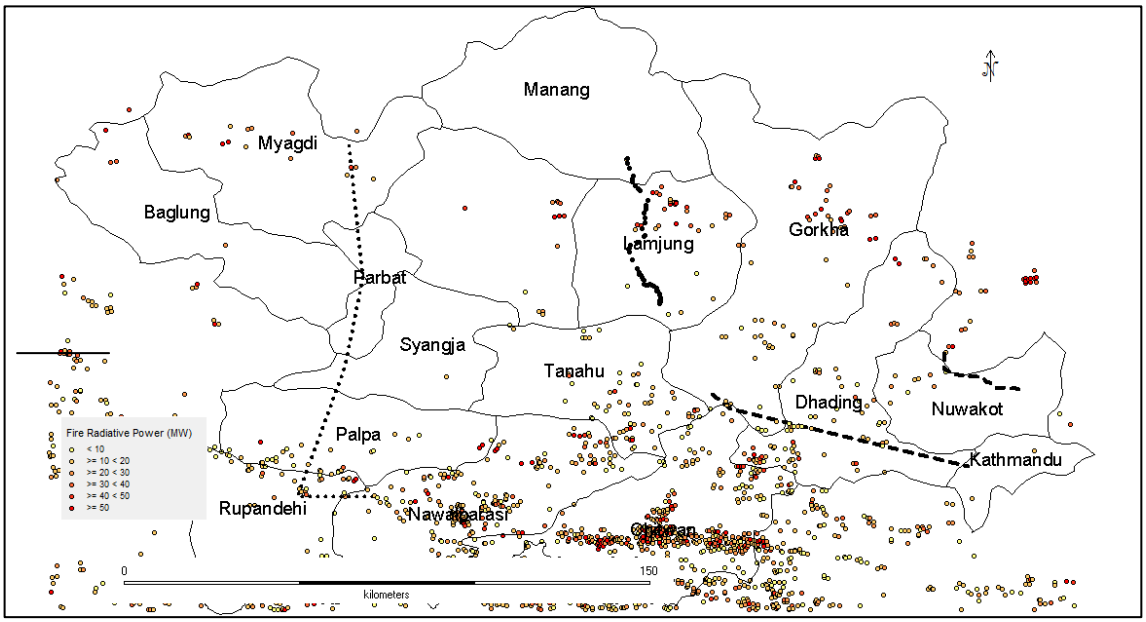
4.6 Fire

Several incidents of fire in the past have been observed along the proposed routes. There were 304 fire incidents in 7 districts of the DKBB Corridor, 589 incidents of fire in MKMB Corridor Districts and 641 incidents of fire along the M-K line Districts between 1 January 2012 to 30 July 2013[63]. Based on routing surveys to date and NASA data for Kaligandaki Corridor the highest density of fire incident along the routing was observed at forests of Siwalik Hills of Dobhan, Devdhaha and Sunwal VDCs of Rupandehi, Palpa and Nawalparasi districts respectively. Relatively fewer number of fires were recorded in Baglung, Parbat and Syangja Districts. In the areas where the MKMB and M-K transmission lines cross over the Siwaliks Hills in Chitwan, there were 400 fires incidents recorded in one year. The areas where the K-B line crosses hills of Tanahu District and Gorkha Districts had 63 and 60 fire incidents, respectively. In Nuwakot District along the Samundratar Trishuli Transmission Line 13 fire incidents have been recorded. The maximum number of occurrences, approximately 50%, were in the month

[63] Maryland, 2002

of April in all the areas. Almost all the occurrences were in forest with Fire Radiative Power (FRP) varying from as low as 5 MW in Palpa District to 207 MW in Gorkha District. The highest frequency these activities occurred between 10-15 MW of FRP, see Figure 4.27. The areas with highest occurrence of fire can be observed in Nawalparasi and Chitwan District of the in Terai Arc Landscape. Besides, Strategic Plan for TAL for 2004-2014 indicates Forest Fire as one of the seven direct causes of Biodiversity loss and environmental Degradation in TAL. Therefore, adequate maintenance of the RoW of the transmission line can be considered to maintain fire line and hence aid in reducing degradation.

Figure 4.27: Fire Occurrence in Project Districts between January 2012 and July 2013



Source: (Maryland, 2002)

……. Kaligandaki Corridor ---------- Marshyangdi Kathmandu Transmission Line
Marshyangdi Corridor

4.6 Potentially Sensitive Ecosystems

The Tenth Five Year Plan (2003-2008) of Government of Nepal incorporated landscape approach as a new strategic and operational direction to conservation and sustainable use of biological resources. Accordingly Ministry of Forest and Soil Conservation in collaboration with its development partners are implementing landscape-specific programmes in various designated areas. This approach to conservation has been adopted to enhance ecological processes and conservation of endangered species, as many of the protected areas are ecological “islands” and too small to support viable population of endangered species and ecological processes.

4.6.1. The Chitwan Annapurna Landscape

The Government of Nepal has identified landscape level planning and conservation as a broad strategy to conserve biodiversity and improve livelihoods of local communities dependent on natural resources. Landscapes are not legally protected areas, but they include and complement protected areas. The GoN recognized two landscapes in Nepal, Terai Arc Landscape (TAL) in 2000 and Sacred Himalayan Landscape (SHL) in 2006, to help establish east-west connectivity that is crucial for biodiversity conservation. Recognizing the need to develop a north-south linkage that is vital to provide a safe passage of river and forest corridors for wildlife, migratory birds and aquatic animals, the Chitwan Annapurna Landscape (CHAL) was envisioned. CHAL is not a new concept. It is based on the Chitwan-Annapurna Linkage for which WWF Nepal had produced a report, 'Biodiversity Assessment and Conservation Planning', in 2000."

The geographic area encompasses an elevation range of over 8000 m, and includes all of the major physiographic zones of Nepal. Figure 4.287 shows the CHAL, which includes all of the Annapurna Conservation Area, most of the Chitwan and Langtang National Parks, and most of the Manaslu Conservation Area (see Table 4.5). The CHAL overlaps with the Terai Arc Landscape (discussed below). Figure 4.29 shows the CHAL relative to other protected areas. Figures 4.28 and 4.29 show clearly that the CHAL occupies roughly a quarter of the total area of Nepal. The CHAL supports over 4.5 million people of diverse ethnicities, Cultures, and religions, many of whom are dependent on forest resources and ecosystem services for their livelihoods and wellbeing.

Comprising the Gandaki River basin in Nepal, the CHAL spans a diverse topography which runs from the trans-himalayan rain-shadow on the Tibet border and part of the Himalaya range in the north, down through the mid-hills and Churia range, to the fertile plains of the Terai in the south bordering with India. This landscape has high biodiversity value and contains seven major river and sub-river basins: Trishuli, Marsyagndi, Seti, Kali Gandaki, Budi Gandaki, Rapti and Narayani; these rivers comprise several thousand megawatts of hydropower potential with numerous hydropower projects at various stages of development, and almost all of the proposed transmission routes are in these basins. Environmental degradation and high poverty rates create a potent mix of threats to both people and biodiversity in the CHAL.

Table 4.5: Protected Areas in and Adjacent to the Chitwan Annapurna Landscape

Protected Area	Year Established	Total Area (ha)	Area in CHAL (ha)
Annapurna Conservation Area	1992	762,900	762,900
Chitwan National Park	1973	93,200	81,200
Dhorpatan Hunting Reserve	1987	132,500	5,400
Langtang National Park	1976	171,000	100,300
Manaslu Conservation Area	1998	166,300	164,000
Parsa Wildlife Reserve	1984	49,900	7,900
Shivpuri National Park	2002	14,400	2,600
Total		1,390,200	1,124,300

Figure 4.28: Chitwan Annapurna Landscape

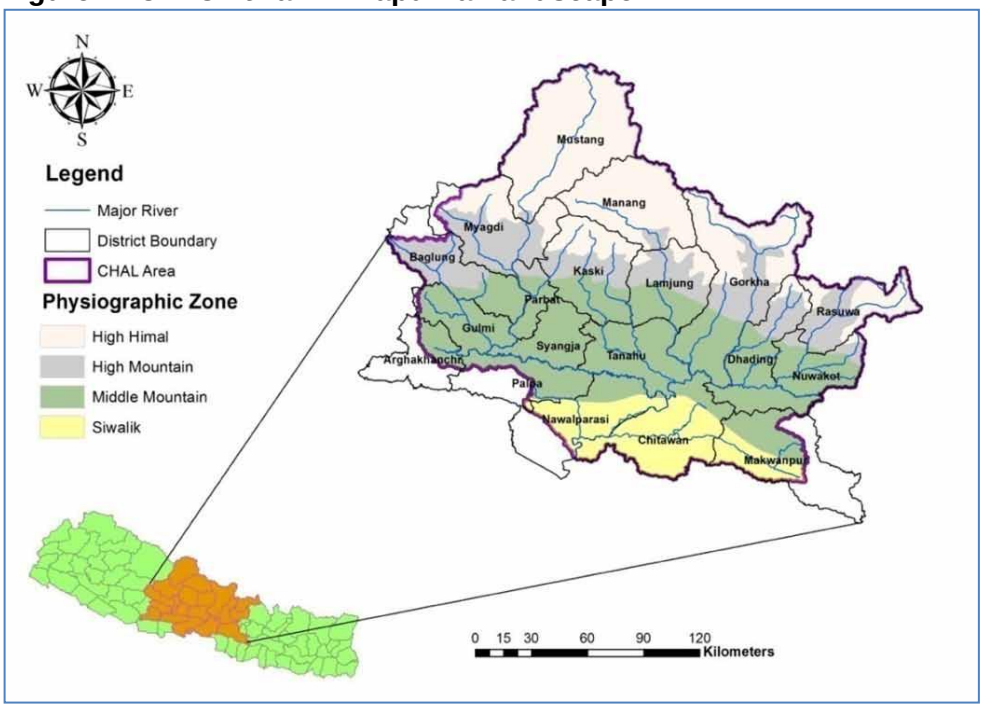
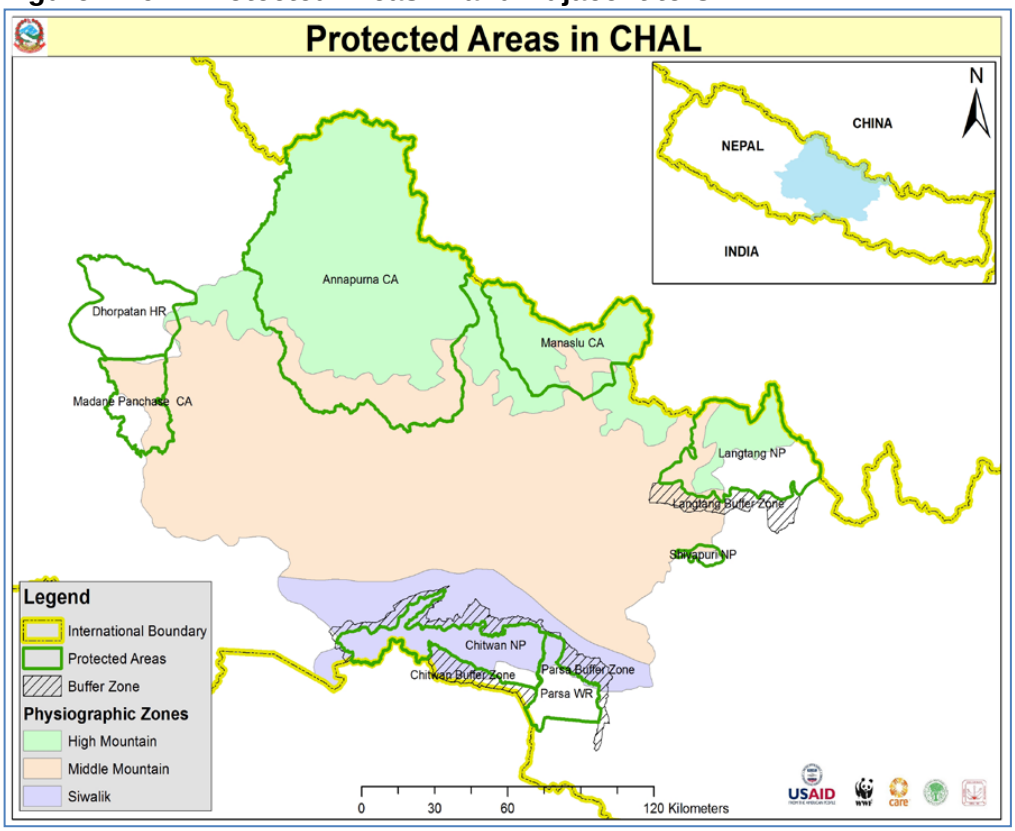


Figure 4.29: Protected Areas In and Adjacent to CHAL



4.6.2. The Terai Arc Landscape

The Terai Arc Landscape (TAL) is composed of eleven Nepalese and Indian trans-border ecosystems of the Terai (Sanskrit for "lowlands) and nearby foothills of the Himalayas. The areas spans approximately 5 million hectares and includes Nepal's Bagmati River to the east and India's Yamuna River to the west (see Figure 4.30). Unlike the CHAL which has an elevation range of 8000 meters, the TAL is defined as part of the physiographic lowlands.

The TAL is home to many endangered mammals including the Bengal tiger (of which it has one of the world's highest densities), the Indian rhinoceros, the gaur, the wild Asian elephant, the hispid hare, the sloth bear, the South Asian river dolphin and the chital, as well as over 500 species of birds, many endangered. Examples of birds are the endangered Bengal Florican, The Sarus Crane, and the Black Stork. The following are the protected areas within the boundaries of the TAL:

- Parsa Wildlife Reserve, Nepal
- Royal Chitwan National Park, Nepal
- Valmikinagar Wildlife Sanctuary, India
- Sohelwa Wildlife Sanctuary, India
- Royal Bardia National Park, Nepal
- Katarniaghat National Park, India
- Dudhwa National Park, India
- Kishanpur Wildlife Sanctuary, India
- Sukla Phanta Wildlife Reserve, Nepal
- Corbett National Park, India
- Rajaji National Park, India

4.6.3. Tiger Conservation Landscape

Tiger Conservation Landscapes are not legally protected areas, but are defined as "areas where there is sufficient habitat for at least five tigers and tigers have been confirmed to occur in the last ten years"[64]. Worldwide, the various TCLs are classified as global priority, regional priority, long term priority, and insufficient data. Regional priority landscapes are areas with moderate probability of persistence of tigers in the long term; they are important for a bioregional tiger conservation strategy. The goal for regional priority TCLs is to restore to Class I status in ten years"[65]. Class I means a habitat which can support a minimum of 100 tigers.

Only 25% of tiger habitat in the world is in protected areas, the rest being in forest where human activity is a dominant component in the ecological system. According to the Global Tiger Initiative, the tiger conservation landscape (TCL) in Nepal is represented by the TAL, see Figure 4.29) stretching over an area of 23,199 km^2 between the Bagmati River in the east and the Mahakali River bordering India in the west.[66]

The Royal Chitwan Landscape is a project commissioned by Save The Tiger Fund and classified as a regional priority landscape; it is not a legally protected area. The Royal Chitwan Landscape (which will be crossed by the Kaligandaki transmission corridor) is considered to have Class II status which means a landscape having a habitat sufficient for 50 tigers with moderate level of threats that can be mitigated in 10 years and a basis for conservation that needs to be improved. The Royal Chitwan Landscape extends

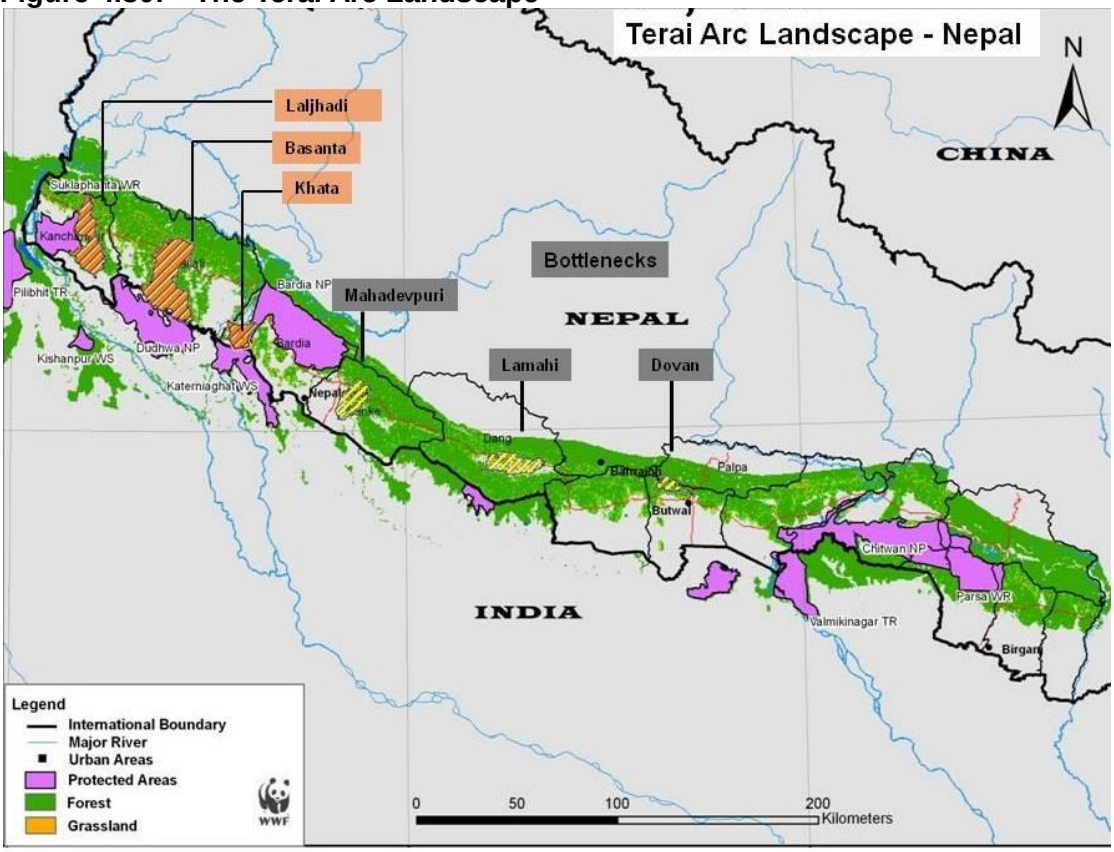
[64] Dinerstein, et al., 2006

[65] Dinerstein, et al., 2006

[66] Global Tiger Initiative Secretariat. 2012. *Managing Tiger Conservation Landscapes and Habitat Connectivity: Threats and Possible Solutions. Experiences from Bangladesh, India, Indonesia, Malaysia, Myanmar, Nepal, Thailand, and Vietnam*. The World Bank, Washington, D.C.

across parts of Nepal and India with an area of 4,055km^2; 31% of the total area is considered to be tiger habitat[67]. The area includes 3 biomes (Tropical & Subtropical Moist Broadleaf Forests, Tropical & Subtropical Coniferous Forests and Tropical & Subtropical Grasslands, Savannas & Shrublands). The Royal Chitwan Landscape near Butwal has been proposed by researchers as part of corridors to connect the tiger sub population in the west. Based on recent survey of tiger population their numbers have increased in Nepal including those in Chitwan National Park.

Figure 4.30: The Terai Arc Landscape



A subset of the TCL is a Tiger Survey Landscape which is defined as "Large Areas of low structural land cover under low human influence where tiger status is unknown. To our knowledge these areas have not been surveyed since 1995"[68]. Although the actual status of tigers is unknown, these landscapes assume that tigers might still be present as these areas are large enough to support at least five tigers[69]. Some of these areas have been surveyed, yet no tigers have been confirmed to be there.

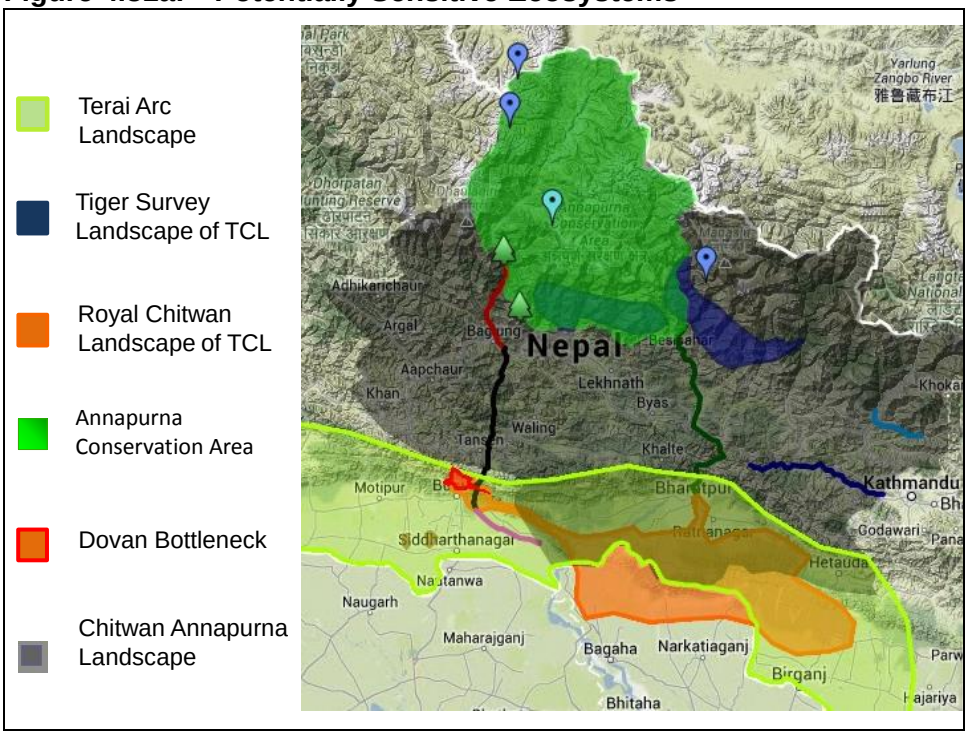
Based on studies done in forest outside protected areas in Terai Arc Landscape it has been found that forests of Dang, Chitwan, Rautahat and Rupandehi Districts have higher probability of tiger occupancy compared to other forest areas outside protected areas in Terai Arc Landscape which act as wildlife corridors[70].

[67] Sanderson, et al., 2006
[68] Sanderson, et al., 2006
[69] Dinerstein, et al., 2006
[70] Karki J. B., 2011

4.6.4. The Dovan Bottleneck

Dovan Bottleneck is located in the Dovan VDC of Palpa District and included as part of Terai Arc Landscape. It is defined as a bottleneck because it is an area where the movement of wildlife is restricted due to geographic and anthropogenic pressure (i.e., human presence). Wildlife in small habitats face genetic and demographic threats due to inbreeding of these isolated populations which depletes their gene pools. In order to maintain a healthy genetic mix, isolated populations need to be linked via corridors for wildlife migration; such migration corridors are important in areas with minimal forest and/or vegetative cover and high human pressure. The Dovan Bottleneck has been identified as an area for connectivity of various species, including the tiger population, between the Chitwan and Bardia National Parks. The draft Nepal Biodiversity Strategy and Action Plan prepared by the Environment Division of Ministry of Forest and Soil Conservation identifies a strategic corridor[71] (not a legally protected area) linking Annapurna Conservation Area with Chitwan National Park as shown in Figure 4.31 a and b. Part of the MKMB line north of Bharatpur Municipality could cross into. In the Dovan VDC approximately 1km section of the Kushma-New Butwal segment of the DKBB line is of Hill Sal forest with 35% crown cover.

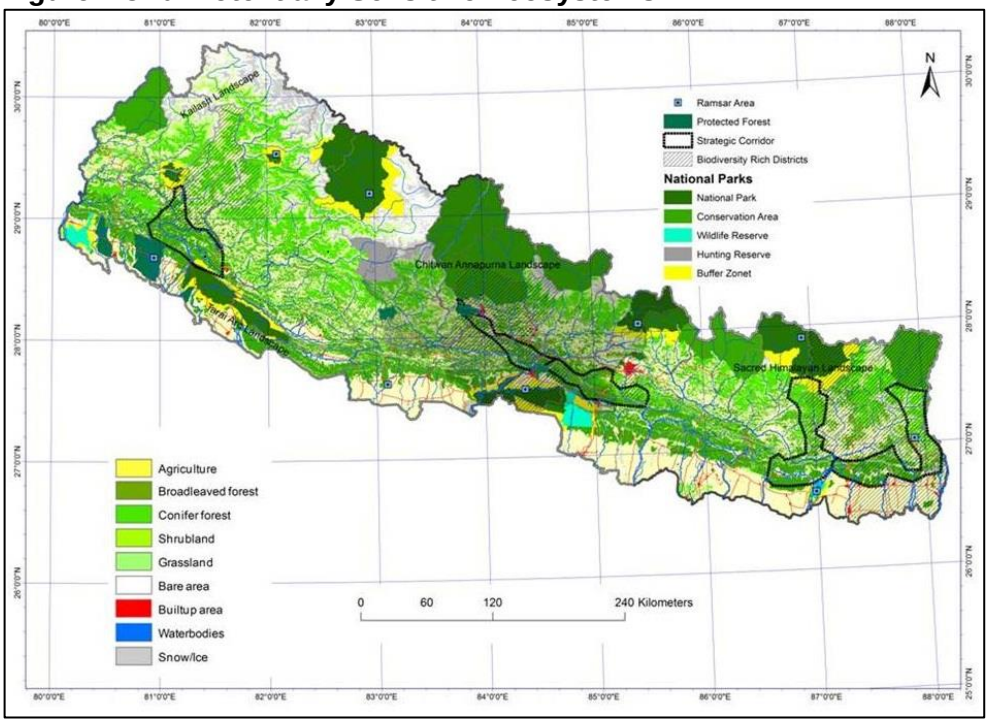
Figure 4.31a: Potentially Sensitive Ecosystems



CHAL = Chitwan Annapurna Landscape, GLOF = Glacier Lake Outburst Flood, TAL = Terai Arc Landscape, TCL = Tiger Conservation Landscape

[71] MoFSC. (n.d.). *Nepal National Biodiversity Strategy and Action Plan.* Retrieved January 20, 2014, from http://www.mfsc.gov.np/noticefile/NBSAP_Draft%20report_138735552

Figure 4.31b: Potentially Sensitive Ecosystems



4.6.5. Annapurna Conservation Area

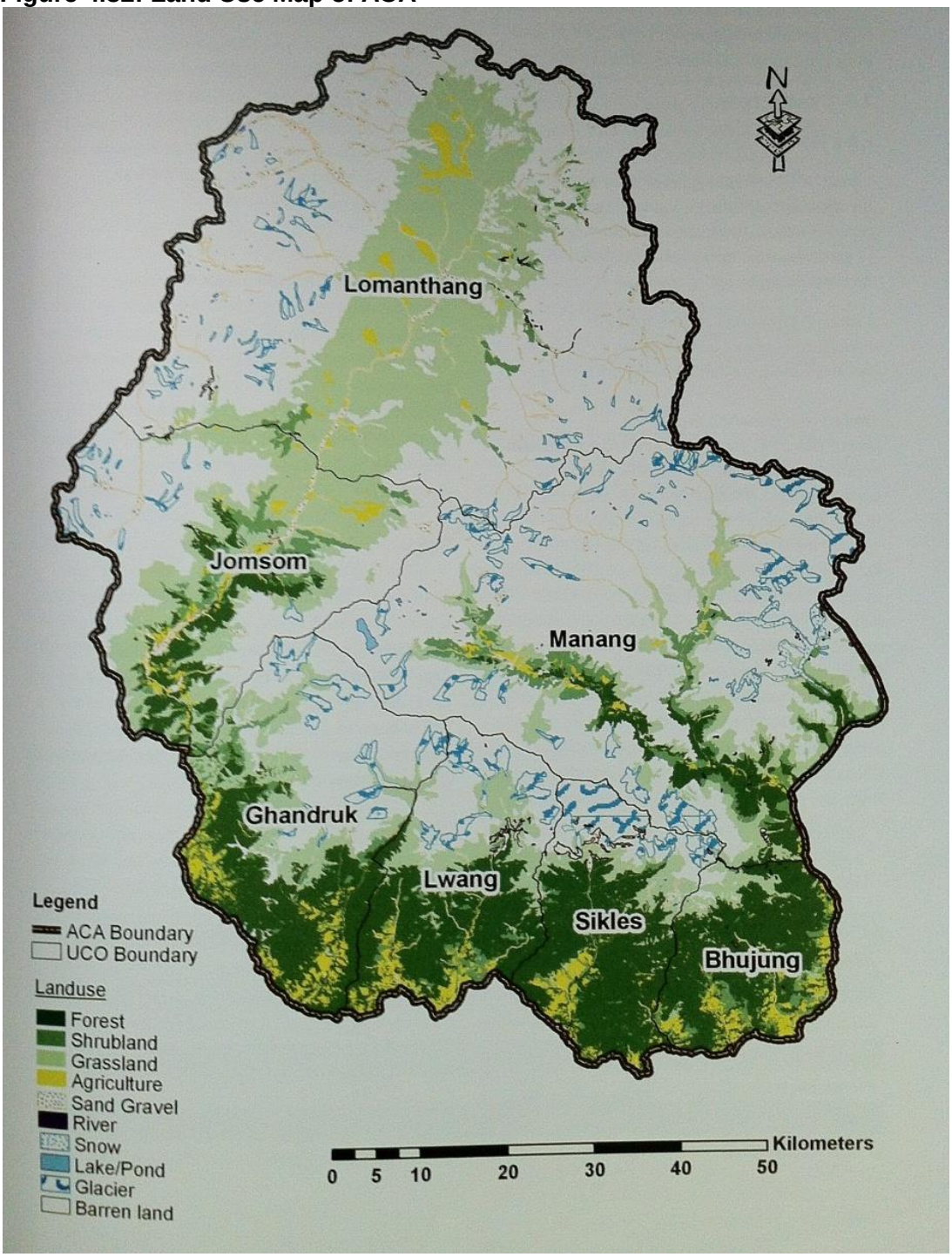
The ACA will be directly affected by the DKBB and MKMB transmission line. ACA is an IUCN Management category VI protected area. ACA was gazetted in 1992 with its management responsibilities handed by Government of Nepal to National Trust for Nature Conservation (NTNC, an autonomous and not for profit organization). It has an area of 7,629 km^2 with 57 VDCs. As shown in Figure 4.32, about 49.7% of the total area is forest, shrubland, and grasslands, about 6.7% is snow, rocks, gravel, rivers, lakes and glaciers, and 3.1% is cultivated land.

Figure 4.33 shows the land use zones within the ACA. Protected forest (which is not distinguished as wilderness zone or intense use zone) and seasonal grazing zone together comprise about 47% of the total area. The proposed routing of the transmission lines is all within intensive land use zones which comprise about 0.018% of the total area (considering 50m RoW). Appendix 4 shows the routing through ACA overlaid over topographic map.

The ACA is the largest protected area and one of the most popular tourist and trekking destinations in Nepal. It is host to the Annapurna mountain range as well as the Kali Gandaki Gorge, the world's deepest. According to 2011/12 data of tourist visiting different protected areas in Nepal provided by Ministry of Culture, Tourism & Civil Aviation of Government of Nepal, a total of 313,126 people visited different protected areas, of which 42% visited Chitwan National Park and 33% visited ACA. This makes it the most visited protected area of the mountainous region of Nepal. According to a recent study, tourists categorized view of the area as the most important factor for attraction to a site[72]. The section between Ghar VDC till Dana VDC that follows close to this trekking route could have some negative impacts.

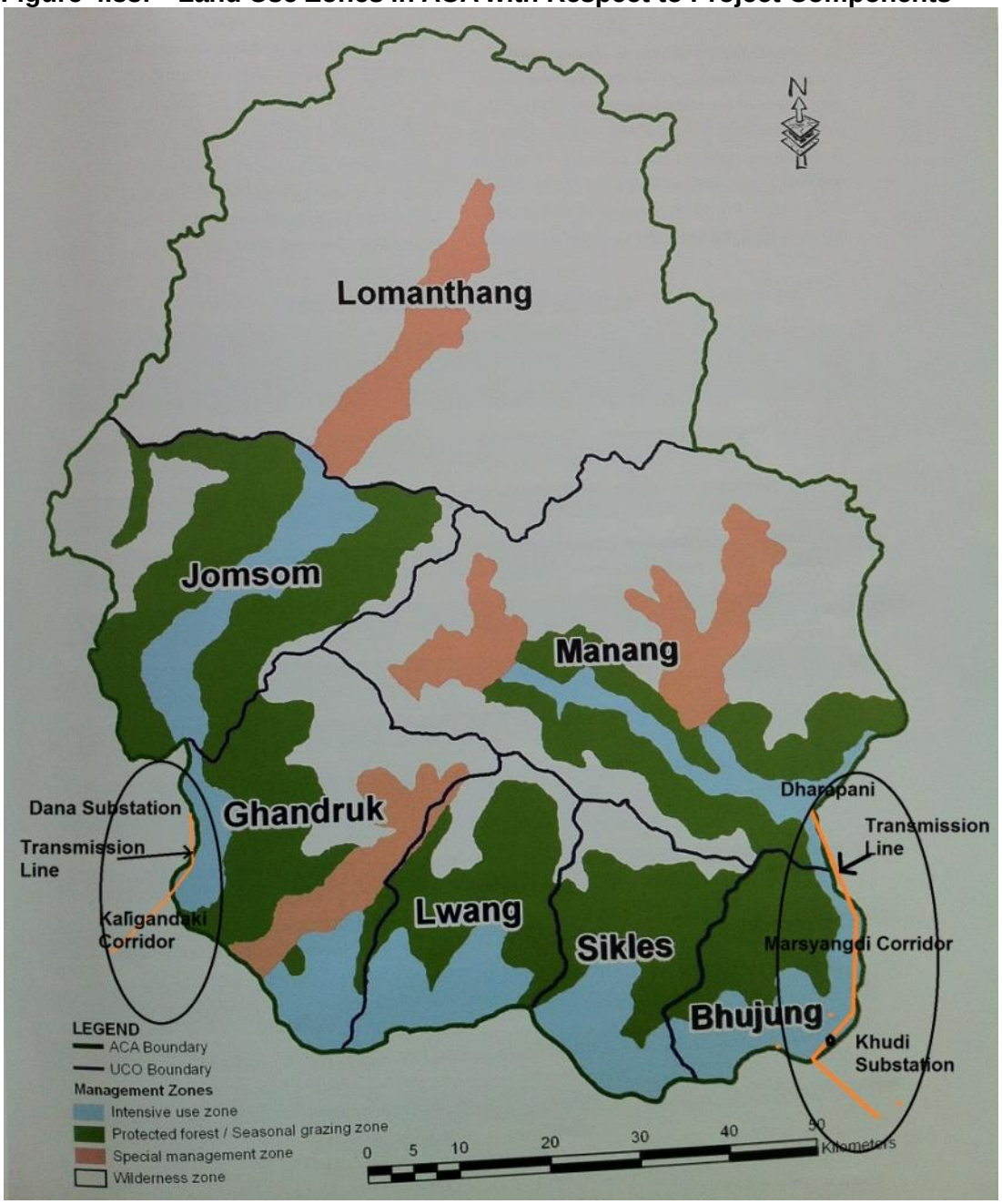
[72] Sharma, 2013

Figure 4.32: Land Use Map of ACA



Source: NTNC, 2008

Figure 4.33: Land Use Zones in ACA with Respect to Project Components



ACA has the largest number of vegetation types in Nepal with forest types being: Hill Sal forest, Subtropical Decidious Hill forest, Schima Castonopsis Forest, Subtropical Semievergreen hill forest, *Pinus roxburghii* forest, *Quercus semecarpifolia* forest, *Quercus lamellose* forest, Lower temperate mixed broadleaved forest, Upper temperate mixed broad leaved forest, Rodhodendron Forest, *Betula utilis* forest, *Abies spectabilis* forest, *Tsuga dumosa* forest, *Pinus wallichiana* forest, *Picea smithiana* forest, *Cupressus torulosa* forest, *Alnus* wood, *Populus ciliate* wood, *Hippophae* scrub, Moist alpine scrub, Dry alpine scrub and *Juniperus wallichiana* forest (NTNC, 2008). The list of the protected plants found in the ACA is given in the Appendix 1[73].

[73] NTNC, 2008

The Kaligandaki Corridor Line passes close to the ACA western boundary next to Kaligandaki River for 6.2 km. Major forest crossed by the transmission line in these sections (based on MENRIS, ICIMOD and Google Earth information) include Alder Forest and Schima Castonopsis Forest. The Alder forest consists of *Alnus nepalensis* and is well known to occur in areas with good moisture such as ravines, river banks and fresh landslide. Furthermore, Schima-Castonopsis Forest mainly composes *Schima wallichii*, *Castonopsis indica*, and *Engelhardia spitica*[74]. The sections of Kaligandaki Corridor crosses over Schima Castonopsis Forest for 1.13km between altitude 1200 to 1250 masl.

The Marsyangdi corridor transmission line crosses approximately 25 km of the eastern part of the ACA between Manang and Khudi, at altitudes of 872-1057 masl. Here too the transmission line crosses over Schema-Castonopsis Forest, 15% with crown cover[75]. Referring to the management zones categorized in the ACA Management Plan, the Manang-Khudi and the Kaligandaki transmission segments noted above are within the intensive use zone (see Figure 4.33) in Bhujung Region (based on Administrative Division of Management Plan) and Lower Marsyangdi Valley respectively (based on Topographical Division of Cis-Himalayan region by the Management Plan).

In general the Marysangdi valley is occupied by extensive human settlement. The "Intensive Use Zone" is generally human settlement area where natural resources have been highly impacted. The human activities are intensive due to agriculture, livestock, fodder, and firewood collection"[76]. The routing through Bhujung and Gandruk districts is within Intensive Land Use zone as shown in Figure 4.32, and most of the proposed ROW will be in agriculture areas rather than forest or other areas. In the Manang district, the proposed ROW will be in agro-pastoral and tourist areas[77].

Most part of the ACA area is barren land (46.8%) followed by 32.24% of grazing land, forest 14.43%., agriculture land 3.17%, shrubland 2.88%, waterbodies 0.41% and landslides 0.07%. The Khudi-Manang transmission segment will pass through the Bhujung, Ghandruk, and Manang Conservation Management Units. The forest and grazing land constitutes 51.76% for Ghandruk, 62.11% for Bhujung and 29.08% for Manang. In contrast to other Units it is observed that Bhujung has larger areas of Forest 53.86% and Landslide (0.53%) while Manang has the least agriculture land 0.58%. The agriculture land distribution being 0.12 ha per person in Manang 0.35 ha per person for Ghandruk and 0.22 ha per person for Bhujung[78].

The fauna of major importance within the protected area includes 97 mammal species, 476 birds, 56 herpato and two fish species[79]. The list of potentially sensitive species is presented in Table 4.6; a more comprehensive set of tables with flora and fauna in potentially sensitive areas is presented in Appendix 1. This number of bird species found here is over half of that found in Nepal. Among these birds the only endemic breeding bird of Nepal Spiny Babbler (*Turdoides nipalensis*) is also found here. Musk Deer in the Conservation Area is found between 3300 to 3700 masl[80]. The Clouded Leopard have been found between 1500 to 3000 masl[81]. However, common leopard,

[74] TISC, 2010
[75] Mulligan, 2005
[76] NTNC, 2008
[77] Yonzon, 1997
[78] NTNC 2008
[79] Bhuju, Shakya, Basnet, & Subha , 2007
[80] Aryal, 2006
[81] Chapagain & Dhakal , 2002

spotted lingsang, Chinese Pangolin, Assamese Monkey, Mustang Frog, Annapurna Ground Skink, Burmese Rock Python, Rat Snake and King Cobra are some important species whose altitudinal range overlaps with the routing elevation in the Conservation Area.

Table 4.6: Important Protected Species in Annapurna Conservation Area

Common names	Scientific names	NPWC Act	NRDB (1995)	IUCN	CITES
Mammals					
Red panda	*Ailurus fulgens*	P	E	VU	I
Snow leopard	*Uncia uncial*	P	E	EN	I
Jungle cat	*Felis chaus*		S	LC	II
Leopard cat	*Prionailurus bengalensis*	P	V	LC	II
Golden cat	*Catopuma temminckii*		V	NT	I
Clouded leopard	*Pardofelis nebulosa*	P	V	VU	I
Marbled cat	*Pardofelis marmorata*		V	VU	I
Himalayan lynx	*Lynx lynx isabellinus*	P	E	LC	II
Forest leopard	*Panthera pardus*		S	NT	I
Dhole	*Cuon alpinus*		V	EN	II
Grey wolf (occupy arctic tundra to forest, prairie, and arid landscapes and prey on musk deer) Source: http://animaldiversity.ummz.umich.edu/accounts/Canis_lupus/ and Musk Deer in Nepal Report	*Canis lupus*	P	V	LC	I
Red fox	*Vulpes vulpes*		S	LC	III
Tibetan sand fox	*Vulpes ferrilata*		S	LC	
Asiatic black bear	*Ursus thibetanus*		V	VU	I
Himalayan brown bear (3800-5500m)	*Ursus arctos*	P	V	LC	I
Indian flying fox	*Pteropus giganteus*			LC	II
Common otter	*Lutra lutra*		S	NT	I
Smooth-coated otter	*Lutrogale perspicillata*		S	VU	II
Spotted lingsang (150-2700 m) IUCN	*Prionodon pardicolor*	P		LC	I
Tibetan argali	*Ovis ammon hodgsoni*	P	C	NT	I
Tibetan gazelle	*Procapra picticaudata*			NT	
Tibetan wild ass	*Equus kiang kiang*			LC	II
Himalayan musk deer	*Moschus chrysogaster*	P	E	EN	I
Himalayan goral	*Naemorhedus goral*		S	NT	I
Mainland serow	*Narmorhedus sumatraensis*		S	NT	I
Chinese pangolin (below 1500 m) Source: IUCN Red List	*Manis pentadactyla*	P	S	EN	II
Assamese monkey (mainly above 1000m) Source IUCN Red List	*Macaca assamensis*	P		NT	II
Rhesus monkey	*Macaca mulatta*		S	LC	II
Herpatofauna					
Indian bull frog	*Hoplobatrachus tigerinus*			LC	II

Mustang frog (2400m) Source: Herpatofauna of Southern Annapurna Region, K.B. Shah	*Paa rostandi*		S	VU	
Annapurna ground skink (2100 to 3360 m) Source: Herpatofauna of Southern Annapurna Region, K.B. Shah	*Asymblepharus capitaneus*		S		
Golden monitor	*Varanus flavescens*	P	S	LC	I
Burmese rock python (1314 to 1800 m) Source: Herpatofauna of Southern Annapurna Region, K.B. Shah	*Python bivittatus*	P	V	VU	I
Rat snake (1080-1700 m) Source: Herpatofauna of Southern Annapurna Region, K.B. Shah	*Ptyas mocosus mocosus*		S		II
King cobra (1800-2300m) Herpatofauna of Southern Annapurna Region, K.B. Shah	*Ophiophagus hannah*		V	VU	I
Source: (NTNC, 2008), (IUCN, 2013), Wikipedia, Birdlife International and CITES Appendix from 5th August 2013. Legend: C= critical, E= endangered, S= susceptible, V= Vulnerable, P= protected, LC (IUCN)= least concern, EN= endangered, VU= vulnerable, CITES (I, II, III)= Appendices					

The figures depicting the potential habitat range of important mammals and bird species are in Appendix 2. The information for these figures was collected from IUCN red list spatial data polygons and ICIMOD's Mountain Geoportal. The habitat ranges cover all potential sites in Nepal. Elevation-based habitat preferences of some important mammals are also presented in Appendix 2.

4.6.6. REDD Forest Demonstration Site

Approximately, 1.5km section of the routing will pass through Banhjakhet VDC of Lamjung District whose community forest (in wards 1, 2 and 3) have been included by NEFIN as demonstration site for REDD activities. Since accurate routing information is not available the tentative site denotes a section crossing over a forest with 30% crown cover.

4.6.7. Summary of Potentially Sensitive Areas Crossed by Proposed Transmission Routes

Table 4.7 summarizes the key locations where sensitive flora and fauna may be impacted by the transmission lines noting prospective mitigation options (mitigation measures are discussed in Sections 5 and 7). The main concern is disturbance of potentially sensitive habitat in forested areas which may be cleared for the ROW. Almost all of the transmission routes proposed lie within the CHAL (see Figure 4.30). About 2.4 km of the Dana-Kushma transmission segment will cross just inside the southwest boundary of the ACA, and about 25 km of the Manang-Khudi transmission segment will be inside the southeast boundary of the ACA (as discussed above). Approximately 30% of the Kushma-New Butwal section of the Kaligandaki Corridor line crosses the TAL, and approximately 15.8 km of this transmission section crosses over the Tiger Conservation Landscape. The Dovan Bottleneck is traversed by approximately 1.8 km section of the Kushma-New Butwal segment of the DKBB line. The MKMB

transmission line will probably cross over sections of Tiger Survey Landscape at Bhanu VDC of Tanahu District, Kabilas VDC, Devghat VDC and Bharatpur Municipality.

Table 4.7: Summary of Potentially Sensitive Project Locations, Impacts, and Mitigation Options

Location	Sensitive species & Habitat Range	Potential Impacts	Mitigation Options
Khudi-Manang segment in ACA (25 km, 220 kV)	Clouded Leopard between 1500 to 3000 m, but preferred habitat is above 2000m	Potential disruption of migration pathways, breeding and/or hibernation areas at higher elevations of transmission line	• 220 kV ➔ not 400 kV • Reforestation @ 25:1 • Minimize RoW width with stacked conductor array • Allow re-vegetation to grow 1-2 meters high in ROW • Implement reforestation as a biodiversity offset?
	Snow leopard between 3000 to 4500 m	No direct impacts	• No specific measures required • Additional assessment will be conducted and mitigation options identified if necessary in EIA for the Khudi-Manang transmission line
	Himalaya musk deer 2500 m and higher	No direct impacts	
	Himalaya wood mouse 2400 to 3500 m	No direct impacts	
Dovan "bottleneck" (~ 1.8 km)	Tiger	Disruption of migration paths due to ROW clearing	• Reforestation @ 25:1 • Allow re-vegetation to grow up to 1 – 2 meters high, facilitating migration • Implement reforestation as a biodiversity offset?
Samundratar - Trishuli 132kV Line: Gerkhu VDC Segment	Assamese Monkey		
	Leopard Cat		

ROW = right of way, VDC = village development committee
Note: Findings are preliminary and will be updated.

4.7 Socioeconomic Conditions

4.7.1. Kaligandaki Corridor

Socio-economic conditions are summarized in Table 4.8. The seven districts of the Western Development Region in Dhawlagiri, Gandaki and Lumbini Zones fall within the project site with a population size of 326,792 constituting 141,835 males and 169,664 females[82]. The mean household size is 4 with 0.2 ha (using 2011 population census data) of cultivated land per person[83]. Subsistence agriculture with livestock raising is the main source of Livelihood in all these Project VDCs. Agricultural land and livestock holdings of households in all the project VDCs is summarized in Table 4.9. Ownership of land is common with 80% of household reporting ownership.

[82] CBS, 2012
[83] MoFSc, DOSC, 2005

Table 4.8: VDC Population of Kaligandaki Corridor

District	VDC	Population					
		Male	Female	Total	Sex Ratio	Total House hold	House-hold Size
Myagdi	Dana	885	988	1,873	90%	484	4
	Tatopani	409	386	795	84%	216	4
	Ghar/Darwang	1,645	1,950	3,595	101%	904	4
	Sikha	1,043	1,169	2,212	84%	621	4
	Histan Mandali	738	937	1,675	86%	492	3
	Dowa	472	591	1,063	80%	294	4
	Beghkhola / Bagarkhola	678	844	1,522	80%	402	4
	Rakhubhagwati	1,461	1,895	3,356	77%	932	4
	Rakhupiple	1,719	2,217	3,936	78%	1,015	4
Parbat	MajhphantMallaj	3,664	4,423	8,087	83%	2,100	4
	Dhairing	1,592	1,864	3,456	85%	896	4
	Nanliwang	1,236	1,515	2,751	82%	683	4
	Pang	1,985	2,581	4,566	77%	1,201	4
	Khurkot	1,724	2,226	3,950	77%	958	4
Baglung	Paiyupata	2,091	2,950	5,041	71%	1,347	4
	Amalachaur	1,878	2,709	4,587	69%	1,206	4
Parbat	Mudikuwa	761	1,108	1,869	69%	467	4
	Falebas Devisthan	1,347	1,657	3,004	81%	697	4
	Khurga	1,316	1,610	2,926	82%	655	4
	Pangrang	958	1,265	2,223	76%	484	5
	Bachchha	816	1,038	1,854	79%	444	4
	Urampokhara	1,064	1,351	2,415	79%	508	5
	Wahakhi / Bahakithanti	719	999	1,718	72%	383	4
	Saligram	1,184	1,497	2,681	79%	578	5
Syangja	Pidikhola	2,161	2,795	4,956	77%	1,119	4
	Bagthala / Bhatkhola	700	959	1,659	74%	450	4
	Shreekrishna Gandaki	3,884	4,931	8,815	79%	1,993	4
Palpa	Yamgha	1,465	2,108	3,573	69%	901	4
	Yarlamdanda / Darlamdanda	878	1,219	2,097	72%	519	4
	Chhapani	852	1,223	2,075	70%	517	4
	Nayarnamtales	951	1,202	2,153	79%	534	4
	Chirtungdhara	1,815	2,451	4,266	74%	1,000	4
	Madanpokhara	2,723	3,558	6,281	77%	1,541	4
	Koldada	1,788	2,077	3,865	86%	661	6
	Dobhan	3,215	3,657	6,872	88%	1,436	5
Rupandehi	Devdaha	12,836	15,378	28,214	83%	6,435	4
	Makrahar	7,634	8,880	16,514	86%	3,479	5
	Kerwani	6,847	7,892	14,739	87%	3,132	5
Nawalparasi	Sunwal	13,347	15,870	29,217	84%	6,537	4
	Amraud	2,374	2,579	4,953	92%	921	5
	Swathi	4,978	5,648	10,626	88%	2,102	5
	Ramnagar	7,103	8,503	15,606	84%	3,315	5
	Ramgram NP	12,807	13,183	25,990	97%	4,972	5
	Manari	2,771	3,011	5,782	92%	1,074	5
	Tilakpur	3,597	4,077	7,674	88%	1,520	5
	Panchnagar	4,483	5,337	9,820	84%	2,156	5
	Makar	11,241	13,356	24,597	84%	5,639	4

Source: Population Census, 2011, CBS

Table 4.9: Ownership of Agricultural Land and Livestock in Kaligandaki VDCs

District	VDC	Households Owning %				
		Agricultural Land Only	Land and Livestock	Land, Livestock and Poultry	Other	Total House-holds
Myagdi	Dana	61	92	252	54	459
	Tatopani	12	30	92	78	212
	Ghar / Darwang	52	96	442	126	716
	Sikha	255	658	286	167	1,366
	Histan Mandali	75	271	169	29	544
	Dowa	63	112	91	21	287
	Beghkhola / Bagarkhola	29	126	174	109	438
	Rakhu-bhagwati	78	178	460	70	786
	Rakhupiple	73	326	379	80	858
Parbat	Majhphant Mallaj	199	368	406	317	1,290
	Dhairing	78	495	111	116	800
	Nanliwang	57	242	159	115	573
	Pang	82	614	168	177	1,041
	Khurkot	67	551	159	81	858
Baglung	Paiyupata	176	792	150	128	1,246
	Amalachaur	96	754	178	75	1,103
Parbat	Mudikuwa	26	313	93	55	487
	Falebas Devisthan	44	281	210	125	660
	Khurga	39	340	257	60	696
	Pangrang	22	218	247	56	543
	Bachchha	11	180	237	34	462
	Uram-pokhara	6	265	205	20	496
	Wahakhi / Bahakithanti	19	281	64	20	384
	Saligram	37	292	145	74	548
Syangja	Pidikhola	38	581	445	94	1,158
	Bagthala / Bhatkhola	41	208	176	46	471
	ShreekrishnaGandaki	69	992	426	1,109	2,596
Palpa	Yamgha	32	587	242	22	883
	Yarlamdanda / Darlamdanda	27	316	123	82	548
	Chhapani	32	239	250	19	540
	Nayarnamtales	45	75	282	102	504
	Chirtungdhara	53	219	554	58	884
	Madanpokhara	109	469	500	157	1,235
	Koldada	10	7	494	15	526
	Dobhan	53	283	754	136	1,226
Rupandehi	Devdaha	889	1,457	1,105	904	4,355
	Makrahar	540	987	869	356	2,752
	Kerwani	380	1,089	569	400	2,438
Nawalparasi	Sunwal	816	1,481	1,199	1,387	4,883
	Amraud	131	306	196	170	803
	Swathi	313	529	554	249	1,645
	Ramnagar	306	933	597	404	2,240
	Ramgram NP	572	1,077	803	1,441	3,893
	Manari	111	271	362	175	919
	Tilakpur	113	277	505	219	1,114
	Panchnagar	185	506	587	372	1,650
	Makar	478	966	828	1,731	4,003

Source: Population Census, 2001, CBS

Out-migration for 2001 in each of these districts varies from 3965 for Myagdi, 12,685 in Parbat, 17,668 in Baglung, 15,546 in Syangja, 24,483 in Palpa, 189,327 in Rupandehi and 97,539 in Nawalparasi Districts[84]. Similarly according to "Districts of Nepal: Indicators of Development" jointly prepared by CBS, Nepal and ICIMOD, these districts are ranked as the most developed area except Nawalparasi District in terms of Socio-economic and Infrastructure Development Index. Ranking for Myagdi, Parbat, Baglung, Syangja, Palpa, Rupandehi and Nawalparasi is 25, 20, 24, 9, 8, 13 and 37 respectively. According to CBS, 2001 87% of the population in 48 VDC's according to Ethnic composition include Hill Bhramin 26.5%, Magar 18.8%, Dalit 14%, Tharu 11.8%, Chhetri 10.4%, Gurung 3.3%, Newar 2.1% and the rest is 13.2% include Yadav, Muslim, Thakuri, Kumal, Kewat, Teli, Sanyasi, Rajbhar, Gharti, Thakali, Majhi, Chhantyal, Kurmi, Mallah, Rai, Lodha and Others (see Table 4.10).

Table 4.10: Ethnic Composition by VDC for Kaligandaki Corridor

VDC		Population						
	Brahmin (Hill)	Magar (Janajati)	Dalit	Tharu (Janjati)	Chhetri	Gurung (Janajati)	Newar (Janajati)	Other
Dana	72	1163	370	0	215	61	13	144
Tatopani	22	478	191	0	57	16	8	107
Ghar	367	1684	788	0	108	172	0	240
Sikha	38	3368	693	0	1491	27	8	148
Histan Mandali	6	2002	102	0	16	0	0	11
Dowa	0	1105	97	0	0	5	0	21
Beghkhola / Bagarkhola	49	1661	284	0	11	21	0	42
Rakhu-bhagwati	236	66	562	0	2277	0	123	230
Piple	441	213	1405	0	844	33	10	1027
Majhphant Mallaj	698	112	1996	0	2460	73	257	469
Dhairin	1943	336	954	0	259	0	0	169
Nanliban	799	267	628	0	961	27	112	39
Pan	2442	42	1248	0	714	12	159	290
Khurkot	2345	23	733	0	688	5	7	287
Paiyupata	1972	12	362	0	104	10	0	50
Amalachaur	1476	139	393	0	268	73	611	282
Mudikuwa	1713	20	499	0	476	578	37	124
Phalebas Devisthan	638	24	651	0	1250	19	33	74
Khurga	313	94	506	0	724	547	56	65
Panran	938	7	669	0	283	18	0	540
Bachchha	2851	95	1475	0	340	903	0	38
Barrachaur	1553	0	56	0	171	0	0	0
Uranpokhara	1324	436	791	0	222	0	147	101
Wahakhi / Bahakithanti	2841	92	1278	0	1300	0	8	84
Saligram	3151	13	1375	0	504	0	9	206
Pidikhola	2757	1177	834	0	699	338	32	123
Numbu-wakharka	2044	1968	385	0	71	0	0	100
Shreekrishna Gandaki	5538	3606	815	75	308	84	372	654
Yamgha	2744	697	563	0	44	0	0	587
Yarlamdanda	1342	1091	71	0	33	0	45	12

[84] KC, 2003

VDC		Population						
	Brahmin (Hill)	Magar (Janajati)	Dalit	Tharu (Janjati)	Chhetri	Gurung (Janajati)	Newar (Janajati)	Other
Chhapani	994	1173	279	0	113	0	49	100
Nayarnamtales	303	1381	303	0	95	0	390	91
Chirtundhara	765	2872	334	0	48	0	112	597
Madanpokhara	2211	2052	1047	0	389	12	187	324
Koldada	6	3667	301	0	0	0	0	28
Dobhan	1038	3418	765	0	994	110	138	276
Devdaha	6338	6437	2321	823	2221	1649	552	1781
Markhar	2417	2017	1514	4377	1490	760	328	1517
Kerwani	2920	2095	1809	2224	583	677	186	2555
Sunwal	5786	4439	2480	3005	3393	1815	765	3375
Amraud	203	212	755	1703	184	30	5	1692
Swathi	1257	939	1039	1806	838	622	70	3131
Ramnagar	4588	1048	1079	2724	622	255	287	1922
Ramgram NP	780	190	3813	4390	840	54	407	12156
Manari	100	11	596	3948	12	0	15	1015
Tilakpur	1067	141	405	3890	159	7	29	846
Panchnagar	2210	517	678	3354	857	109	232	621
Makar	5604	2869	2517	3692	2041	1112	685	2074
Total	**81,240**	**57,469**	**42,809**	**36,011**	**31,777**	**10,234**	**6,484**	**40,365**

Source: Population Census, CBS 2001.

4.7.2 Marsyangdi (MKMB) Corridor

For this corridor five districts of Western and Central Development Region of Gandaki and Narayani Zone will be traversed. The total population of these districts sum up to 134,8595 with 623,112 male and 725,483 female with average household size of 4.2 and 0.2 ha of cultivated land per person. Subsistence agriculture with livestock raising is the main source of Livelihood in all these Project VDCs. Agricultural land and livestock holdings of households in all the project VDCs is summarized in Table 4.11. Ownership of land is common with 80% of household reporting ownership.

Table 4.11: Ownership of Agricultural Land and Livestock in Marsyangdi Corridor VDCs

District	VDC	Households Owning (%)				Total Households
		Agricultural Land Only	Land and Livestock	Land, Livestock and Poultry	Other	
Manang	Dharapani	25	49	71	189	176
Lamjung	Ghermu	39	82	222	120	382
	Taghring / Tharding	65	75	255	57	454
	Bahundada	26	179	190	614	474
	Khudi	64	203	325	92	732
	Bhulbhule	64	183	310	26	664
	Chandisthan	28	107	216	392	411
	Bajhakhet /	72	240	310	47	706

District	VDC	Households Owning (%)				Total Households
		Agricultural Land Only	Land and Livestock	Land, Livestock and Poultry	Other	
	Beshisahar					
	Gaunsahar	133	516	727	36	1511
	Udipur	56	288	163	160	623
	Chiti	55	304	725	296	1179
	Bhoteoodar	115	357	276	22	1295

Source: Population Census, 2011, CBS

Out-migration for 2001 in each of these districts varies from 1,253 for Manang, 10,877 in Lamjung, 32,482 in Tanahu, 11,667 in Gorkha and 162,528 in Chitwan Districts (KC, 2003). According to "Districts of Nepal: Indicators of Development" jointly prepared by CBS, Nepal and ICIMOD, these districts are ranked as the intermediate developed area except Manang and Chitwan District in terms of Socio-economic and Infrastructure Development Index. Ranking for Manang, Lamjung, Tanahu, Gorkha and Chitwan is 10, 30, 31, 45 and 4 respectively. According to CBS, 2001 87% of the population in 48 VDC's according to Ethnic composition include Hill Bhramin 26.5%, Magar 18.8%, Dalit 14%, Tharu 11.8%, Chhetri 10.4%, Gurung 3.3%, Newar 2.1% and the rest is 13.2% include Yadav, Muslim, Thakuri, Kumal, Kewat, Teli, Sanyasi, Rajbhar, Gharti, Thakali, Majhi, Chhantyal, Kurmi, Mallah, Rai, Lodha and Others[85].

4.7.3 M-K Line

Altogether four districts of Western and Central Development Region of Gandaki and Narayani Zone will be traversed. Total population of these districts is 2,931,352 with 1,470,962 male and 1,460,389 female having 4.2 as average household size as shown in Table 4.12[86]. Average cultivated land person here is 0.1 ha. Subsistence agriculture with livestock raising is the main source of Livelihood in all these Project VDCs. Agricultural land and livestock holdings of households in all the project VDCs is summarized in Table 4.13. Ownership of land is common with 88% of household reporting ownership.

Table 4.12: VDC Population of Marki Chowk - Kathmandu Line

District	VDC	Population					
		Male	Female	Total	Sex Ratio	Total Household	Household Size
Gorkha	Deurali	2,449	3,065	5,514	80%	1,422	4
	Manakamna	2,876	3,327	6,203	86%	1,392	4
	Ghyalchok	2,759	3,193	7,744	86%	1,442	5
Chitwan	Darechok	4,836	4,771	9,607	101%	2,029	5
Dhading	Jogimara	3,842	3,902	5,952	98%	1,298	5
	Salang	2,655	2,995	5,650	89%	1,140	5
	Benighat	4,854	4,863	9,717	100%	2,123	5
	Kumpur	4,636	5,376	10,012	86%	2,122	5
	Kalleri	4,059	4,793	8,852	85%	1,921	5

[85] Additional details will be added when complete VDCs of the Marshyangdi-Bharatpur routing by NEA survey is provided.

[86] CBS, 2012

District	VDC	Population					
		Male	Female	Total	Sex Ratio	Total Household	House hold Size
	Pida	5,415	5,628	11,043	96%	2,214	5
	Baireni	6,630	6,739	13,369	98%	2,795	5
	Goganpani	2,696	2,867	5,563	94%	1,133	5
	Kewalpur	2,412	2,598	5,010	93%	1,104	5
	Thakre	4,781	5,057	9,838	95%	2,141	5
	Naubise	7,203	7,350	14,553	98%	3,184	5
Kathmandu	Baad Bhanjyang	1,873	1,906	3,779	98%	817	5

Source: Population Census, 2011, CBS

Table 4.13: Ownership of Agricultural Land and Livestock in Marki Chowk - Kathmandu VDCs

District	VDC	Households Owning (%)				Total Households
		Agricultural Land Only	Land and Livestock	Land, Livestock and Poultry	Other	
Gorkha	Deurali	90	273	692	189	1244
	Manakamna	97	579	409	120	1205
Gorkha	Ghyalchok	51	174	164	57	446
Chitwan	Darechok	133	338	563	614	1648
Dhading	Jogimara	46	436	583	92	1157
Dhading	Salang	14	314	660	26	1014
	Benighat	121	882	279	392	1674
	Kumpur	49	481	1198	47	1775
	Kalleri	31	438	1222	36	1727
	Pida	77	380	1197	160	1814
	Baireni	90	861	888	296	2135
	Goganpani	24	279	605	22	930
	Kewalpur	38	447	501	25	1011
	Thakre	122	748	534	195	1599
	Naubise	184	1148	987	411	2730
Kathmandu	Baad Bhanjyang	95	266	201	104	666

Source: Population Census, 2001, CBS

Similarly out-migration for 2001 in each of these districts varies from 1,1667 for Gorkha, 162,528 in Chitwan, 13,949 in Dhading and 346,190 in Kathmandu Districts[87]. Kathmandu and Chitwan rank as among the most developed in terms of socioeconomic and infrastructural development index while Dhading District is considered as among the least developed[88]. Ranking for Gorkha, Chitwan, Dhading and Kathmandu is 45, 4, 54 and 1 among 75 districts of Nepal. According to CBS, 2001 87% of the population in 16 VDC's according to Ethnic composition include Hill Bhramin 19%, Chhetri 17%, Tamang 12%, Dalit 12%, Magar 12%, Newar 9%, Gurung 7% and others 13%. The others include Chepang, Gharti/Bhujel, Sanyasi, Muslim, Thakuri, Tharu, Sherpa, Kumal, Rai, Darai and rest (Table 4.14).

[87] KC, 2003
[88] ICIMOD, 2003

Table 4.14: Ethnic Composition by VDC for M-K Line

VDC		Population						
	Brahmin (Hill)	Chhetri	Tamang (Janjati)	Dalit	Magar (Janajati)	Newar	Gurung (Janjati)	Others
Deurali	747	1,673	130	969	887	376	344	594
Manakamna	363	91	16	659	3,130	758	1,453	51
Ghyalchok	1,408	683	7	1,209	397	811	909	716
Darechok	916	727	228	562	1,680	619	2,243	2,134
Jogimara	555	691	25	346	811	486	762	3,306
Salang	1,074	66	0	888	2,741	607	12	519
Benighat	2,392	1,437	336	1,582	476	579	497	1,007
Kumpur	1,619	464	0	1,752	1,357	2,135	1,848	881
Kalleri	2,345	1,007	5	2,080	2,048	1,375	0	735
Pida	1,560	1,908	1,570	1,017	541	574	99	3,027
Baireni	2,406	2,497	3,930	1,410	297	604	64	613
Goganpani	1,008	827	1,604	555	574	387	70	408
Kewalpur	2,201	994	973	690	84	506	93	225
Thakre	1,597	4,099	1,692	323	158	193	90	913
Naubise	3,554	3,199	4,055	1,124	179	1,110	89	1,358
Baad Bhanjyang	752	1,251	724	287	36	118	20	98
Total	**24,497**	**21,614**	**15,295**	**15,453**	**15,396**	**11,238**	**8,593**	**16,585**

Source: Population Census, 2001.

The average electrification rate for lighting for Nepal is 67%[89]. Based on the district traversed by the project transmission line it has been observed to be higher than national average varying from 69% in Myagdi to 98% in Kathmandu. The average electrification rate being 80%, 81%, 79% and 85% for DKBB, MKMB, M-K and ST lines respectively.

Major crops cultivated here in subsistence manner are paddy, wheat, corn, millet, and potatoes followed by sugarcane, barley, legumes, vegetables and fruits[90]. Suitable areas along the corridors for the potential of growing major crops are provided in the Appendix 2 Figure 1 to 7 (these are based on software analysis of agro ecological zones of FAO). Almost all farmers do subsistence farming. DKBB corridor has a population density by agriculture land from 4, 5, 5, 5, 5, 9 and 9 persons per hectare for project VDCs of Myagdi, Parbat, Baglung, Syangja, Palpa, Rupandehi and Nawalparasi Districts respectively. Similarly, based on per capita food production for 2001 indicate Rupandehi and Syangja as most developed with 4250 and 3640 Kilocalories. Parbat, Nawalparasi, Myagdi and Palpa have been classified as Intermediate with 3518, 3366, 3143 and 2792 Kilocalories respectively. Baglung with 2634 Kilocalories is designated under least developed[91].

[89] CBS, 2012
[90] Gautam, et al., 2012
[91] ICIMOD, 2003

4.7.3 S-T Line

One district of Central Development Region of Bagmati Zone will be traversed. Total population of this district is 277,471 with 132,787 male and 144,684 female having 4.69 as average household size as shown in Table 4.15.[92] Average cultivated land person here is 0.21 ha. Subsistence agriculture with livestock raising is the main source of Livelihood in all these Project VDCs. Agricultural land and livestock holdings of households in all the project VDCs is summarized in Table 4.16. Ownership of land is common with 96% of household reporting ownership.

Table 4.15: VDC Population of S-T Line

District	VDC	Population					
		Male	Female	Total	Sex Ratio	Total Household	Household Size
Nuwakot	Manakamna	1,537	1,784	3,321	86%	789	4
	Tupche	2,401	2,885	5,286	83%	1,279	4
	Gerkhu	2,888	3,494	6,382	83%	1,421	4
	Bageshwari	2,382	2,604	4,986	91%	1,073	5
	Lachyang	2,238	2,242	4,480	100%	876	5
	Narjamandap	2,656	2,679	5,335	99%	1,012	5
	Kharanitar	779	830	1,609	94%	375	4
	Ralukadevi	2,299	2,264	4,563	102%	916	5
	Thaprek	1,902	2,040	3,942	93%	760	5
	Sundaradevi	1,207	1,204	2,411	100%	511	5
	Balkumari	1,230	1,256	2,486	98%	496	5

Source: Population Census, 2011, CBS

Table 4.16: Ownership of Agricultural Land and Livestock in S-T Project Area VDCs

District	VDC	Households Owning%				
		Agricultural Land Only	Land and Livestock	Land, Livestock and Poultry	Other	Total Households
Nuwakot	Manakamna	38	181	484	17	720
	Tupche	57	343	703	59	1,162
	Gerkhu	63	369	822	87	1,341
	Bageshwari	45	314	593	63	1,015
	Lachyang	26	65	659	13	763
	Narjamandap	53	319	553	38	963
	Kharanitar	18	188	94	35	335
	Ralukadevi	56	157	681	31	925
	Thaprek	14	63	650	14	741
	Sundaradevi	59	106	495	21	681
	Balkumari	35	48	383	20	486

Source: Population Census, 2001, CBS

[92] CBS, 2012

Similarly out-migration for 2001 in this district was 12,367[93]. For 2001 Nuwakot ranked as among the intermediate with rank 32 in terms of socioeconomic and infrastructural development index in Nepal[94]. Similarly, according to CBS, 2001 43% of the population in 11 VDC's according to Ethnic composition include Tamang, Hill Bhramin 20%, Chhetri 19%, Dalit 6%, Newar 4%, Gurung 2%, Magar 1%, and others 4%. The others include Rai, Gharti/Bhujel, Sherpa, Sanyasi, Kumal, Thakuri, Bhote and rest (Table 4.17).

Table 4.17: Ethnic Composition by VDC for S-T Line

VDC		Population						
	Tamang (Janajati)	Brahmin (Hill)	Chhetri	Dalit	Newar (Janajati)	Gurung (Janajati)	Magar (Janajati)	Others
Manakamna	1,831	790	64	198	34	575	0	252
Tupche	1,425	1,925	1,769	725	37	12	89	282
Gerkhu	1,984	2,485	1,325	283	498	112	271	369
Bageshwari	2,089	1,410	881	420	58	130	319	137
Lachyang	3,694	0	46	105	34	228	0	18
Narjamandap	2,510	1,375	722	262	274	40	0	228
Kharanitar	487	461	192	101	410	0	0	72
Ralukadevi	2,477	592	1,240	406	311	102	0	83
Thaprek	2,062	32	1,455	235	56	0	24	205
Sundaradevi	701	530	744	223	243	0	0	23
Balkumari	1,653	75	484	99	54	0	0	80
Total	**20,913**	**9,675**	**8,922**	**3,057**	**2,009**	**1,199**	**703**	**1,749**

Source: Population Census, 2001.

The average electrification rate for lighting for Nepal is 67%[95]. Based on the district traversed by the project transmission line it has been observed to be higher than national average with 85% having electricity for lighting (with or without solar).

Major crops cultivated here in subsistence manner are paddy, wheat, corn, millet, and potatoes followed by barley, legumes, vegetables and fruits[96].

[93] KC, 2003
[94] ICIMOD, 2003
[95] CBS, 2012
[96] Gautam, et al., 2012

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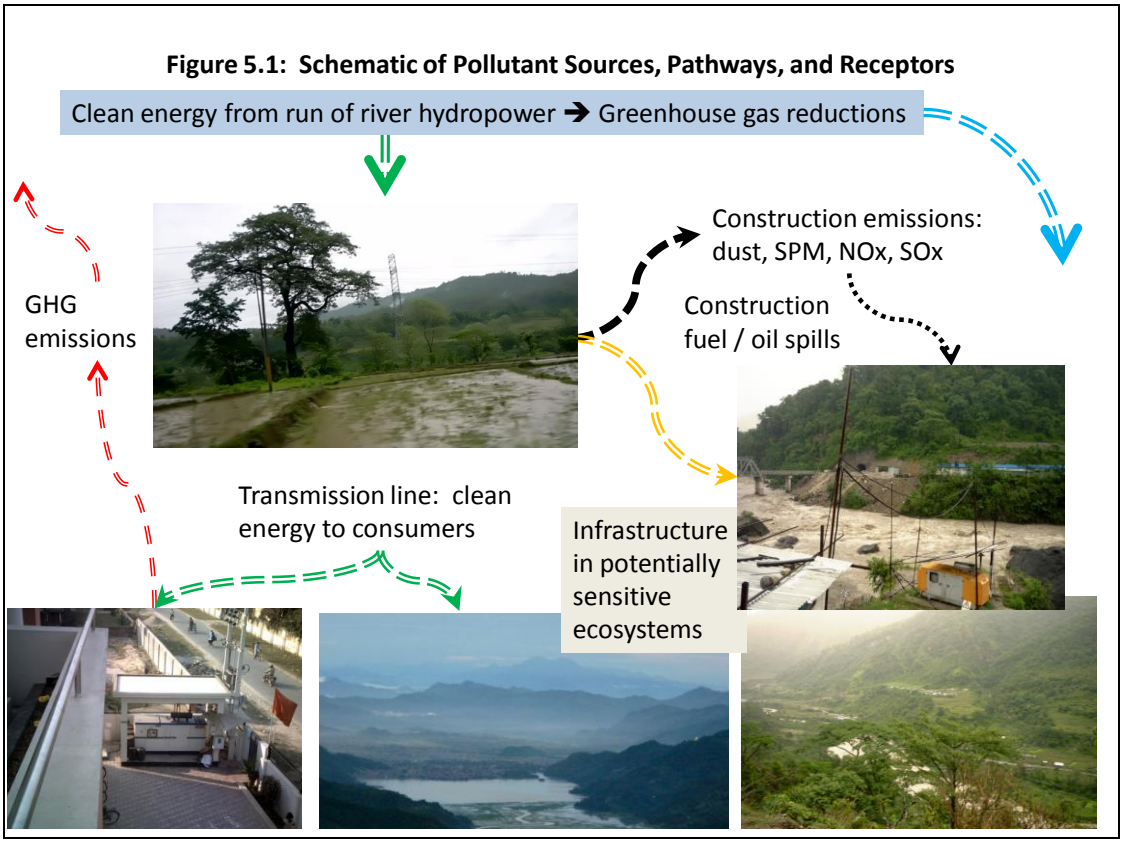
5. Anticipated Impacts and Mitigation Measures

Environmental impacts will vary considerably for each of the main transmission lines included in the project. Under the Nepali regulatory framework, an IEE or EIA is required for each transmission line; the project will require IEEs for all lines except the Manang-Khudi line at the north end of the Marsyangdi corridor. The IEEs and EIA will identify site-specific impacts and mitigation measures will be identified in detail. This section provides a consolidated discussion based on desk studies and field reconnaissance conducted in 2013 and 2014.

The potential impacts are illustrated conceptually in Figure 5.1, showing possible pollutant sources, pathways, and receptors. Transmission systems are generally considered to be "non-polluting" as there are no emissions of air pollutants, wastewater, or solid wastes associated with transmission lines; however, there are domestic wastes from substation operations.

Figure 5.1: Schematic of Pollutant Sources, Pathways, and Receptors



A total of 399 km of transmission line are included in the project, plus 9 substations. The total footprint of these facilities is about 1,880 ha.[97] The transmission lines have potential environmental sensitivity, in particular the 25 km segment from Manang to Khudi which includes 2 new substations. The Manang-Khudi facilities have a total footprint of 135 ha, which is about 7% of the total project footprint. There are also 2 associated hydropower projects under construction in the Annapurna Conservation Area (ACA) or on its boundary, with several more in the development queue.

The project activities comprise clearing of right-of-way, construction of new transmission towers and substations, and augmentation of existing substations. Disturbance during

[97] For purposes of environmental assessment, this assumes 9 substations with 5 ha per substation, and 399 km of transmission ROW with a width of 46 meters. The actual footprint is expected to be smaller.

construction will arise from temporary access road construction, clearing of vegetation, equipment staging, construction of substations, erection of transmission towers, and stringing of conductors on the towers. The potential impacts will occur mainly during construction due to minor earthworks, equipment staging, and temporary construction camps. The anticipated impacts are mostly localized, minimal, temporary, and reversible, and can be readily mitigated.

As shown in Figure 5.1, the project will have long-term benefits by facilitating power trading, connection of clean energy capacity to the grid, reducing load shedding, and reducing reliance on diesel-fired generators. The project will create short-term employment opportunities during construction, mostly for unskilled and semi-skilled labor.

Construction Procedures

Tower Foundation

The construction of tower foundation will be undertaken by manual labor assisted by the mechanical plant wherever possible. The mechanical plant will be limited to small demountable steel skid framed concrete mixers, air compressors, air drills/chisels and tamping/compaction tools. Excavation and the concreting of the tower foundations will be carried out as per the design requirements and after necessary curing, the foundations will be backfilled with suitable material.

Erection of Galvanized Steel Towers

Galvanized steel lattice tower components manufactured in the factory will be transported to the individual tower locations. Towers are erected manually by employing pulleys, winches, etc. into the tower foundations. Construction cranes will not be used.

Insulator Fittings, Conductor and Ground Wire Stringing

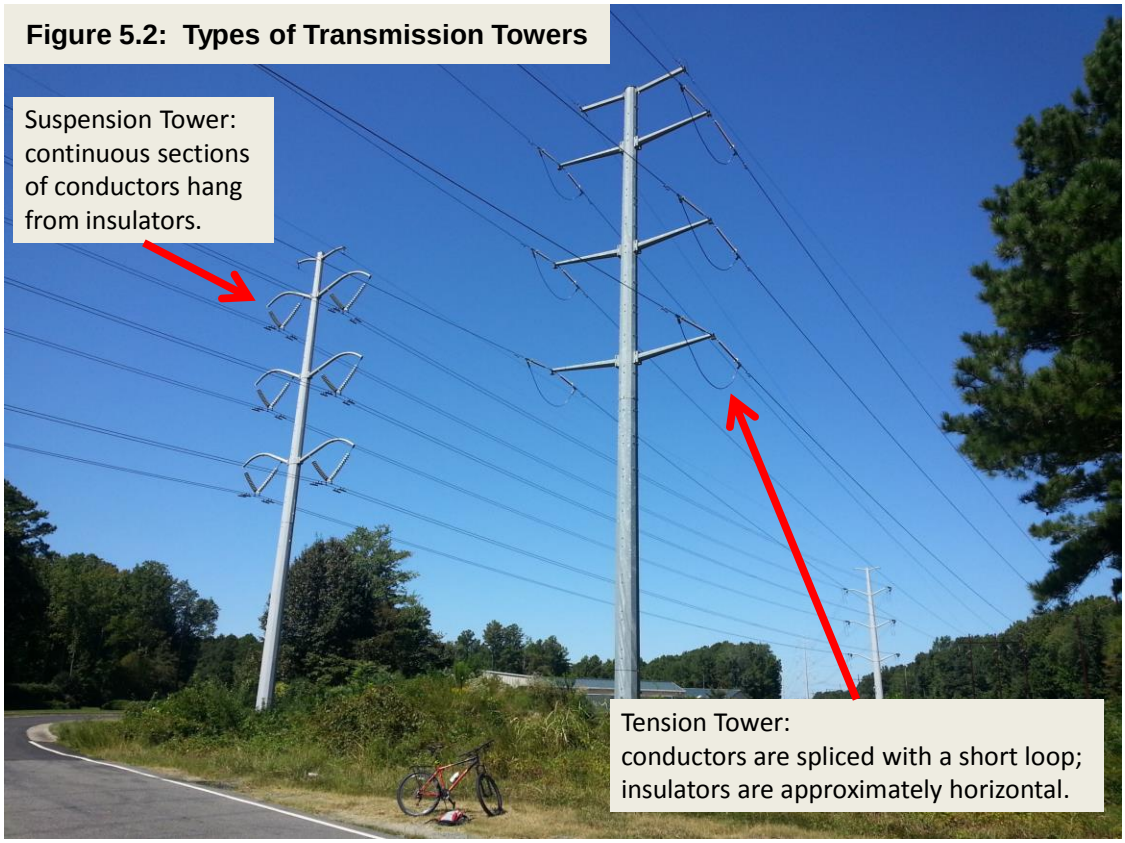
Conductors, ground wires, insulators and necessary accessories will be transported manually to the tower locations. The fitting of insulators on the tower and stringing of conductors and ground wire will be carried out manually as per design requirements. Construction cranes will not be used.

The transmission line utilizes 2 types of towers: (i) tension towers, where conductors are spliced with a loop across insulators; and (ii) suspension towers, from which the conductors (wires) are hung from insulators (see Figure 5.2). Suspension towers are used for straight segments of the line, while tension towers are normally used for angles in the alignment. Typically there are several suspension towers with a continuous conductor between 2 tension towers.

A series of pulleys are installed on the transmission towers in a working segment between tension towers. A guide rope or wire is passed from one end of the segment through the successive pulleys until the other end of the segment is reached. The guide rope installation requires traversing the ROW either manually or with a tractor or truck.[98] The conductors are attached to one end of the guide rope, which is then pulled by a powered winch. After the conductors are pulled through the working segment, they are drawn mechanically to the design tension, and then attached to the insulators. The construction technique results in limited disturbance to flora and fauna in the ROW.

[98] It is technically possible to string lines with helicopters but this technique has not been used in Nepal. Construction contractors are at liberty to propose this technique.

Figure 5.2: Types of Transmission Towers



Source: D. Millison, 2013; location is in York County, Virginia USA.

The typical construction crew comprises around 25 people, with maximum of 40 people. Multiple crews will be working along the route at any given time. Construction staging areas and camps will be occupied for a maximum of one month. The largest work teams will be deployed for construction of tower footings. The excavation and concreting work will require about 7 – 10 days per tower site. Smaller teams will be deployed for installing insulators and stringing conductors, and will be at each work site for about 4 days. About 30% of the labor force is expected to be local. The mobile workforce will be housed in temporary camps.

The likely adverse impacts during construction and operation of the transmission lines and substations relative to existing baseline conditions are discussed below in terms of physical, biological and socio-economic and cultural environment, and split into the construction and operation phases.

5.1 Physical Environment

The main physical impacts arise from land use for conductor stringing, construction of tower pads, and minor changes in drainage patterns. Impacts are localized, short term, and reversible, except for small areas where forest clearing is required and where sensitive receptors may be present.

5.1.1Topography, Land use and Land take

5.1.1.1 Construction Phase

The land use changes are due to the temporary land acquisition along the right-of-way (ROW) and for construction of tower pads which require permanent land use changes. The permanent land use change may result in loss of agricultural production and other resources base in the cultivated land and private forest. The ROW constitutes land fragmentation. The towers typically require an area of about 18 m x 18 m, or 324 m^2 for each tower. A maximum of 5 ha of land is required each substation, and up to 2 ha will be required temporarily for construction camps. The impact is classified as high in magnitude, local in terms of area or

geographic extent, and of long-term duration.

5.1.1.2 Operation Phase

Use of land in the ROW is restricted to agriculture and similar activities which do not interfere with the towers and conductors. Construction of dwellings and permanent human habitation is not allowed in the ROW. All temporary land acquired will be converted to its original use or agreed new uses towards the end of the construction period. The impact can be classified as high in magnitude, local in terms of extent, and of long-term in terms of duration.

5.1.2Watershed and Drainage

The transmission lines runs area almost all located in hilly regions, and interference with drainage patterns due to the construction of the tower pads will be minimum. Substation sites will result in minor alteration of drainage patterns.

5.1.2.1 Construction Phase

The impact due to site clearing, stringing of the line, excavation for tower construction and material transportation may disturb watershed condition, but the impact will be minimal as disturbance is limited to approximately 324 m^2 of land for each tower pad. The actual area for each tower pad will vary as with the specific location, height, and weight of the tower. The earthwork associated with tower construction will be limited to concrete footings with soil disturbances confined to tower bases. Therefore no significant impact is expected. The cultivated area around the tower pads may be affected due to compaction during the construction and transportation of materials.

Disruption of natural drainage lines and soil erosion while stringing lines across rivers can be anticipated during the construction phase. Towers will be located away from rivers and streams to minimize disturbance on water flow and to minimize the risk of flood damage to the tower pads. Overall disruption of natural drainage will be insignificant. The impacts are site specific, low in magnitude and for a short duration.

5.1.2.2 Operation Phase

Physical disturbances during operation are essentially non-existent. No significant impact on the watershed, soil and geology is expected during the operation and maintenance period.

5.1.3Air Quality

5.1.3.1 Construction Phase

The impact on air quality during the construction period is expected to be insignificant, as site clearance, excavation, concreting are localized and short term. Transportation of the materials and movement of construction crews and equipment will cause minor impact on air quality, mainly due to dust and vehicle exhaust emissions. The impacts are low in magnitude, site-specific, and short duration.

5.1.3.2 Operation Phase

No air impacts are expected during the operation phase from transmission lines. Emissions from substations are limited to vehicle traffic associated with staff going to and from work.

5.1.4Noise and Vibration

5.1.4.1 Construction Phase

The emission of noise and vibrations are inevitable during construction. The ROW have been selected to avoid settlements as much as possible. Impacts will be arise from vehicular movement and construction activities, but will be temporary and represent only a minor increase in disturbance above prevailing traffic conditions on existing roads. The impact is expected to be low in magnitude, site specific and for a short duration.

5.1.4.2 Operation Phase

Overhead transmission lines do create some noise in certain circumstances: minor surface damage, dirt or some weather conditions can cause the lines to crackle or hum slightly, which is known as corona effect. Corona effect is conspicuous during rain. Noise impacts are minimized by maintaining mandatory set-back distance from settlements. The impact is expected to be low in magnitude, long termed and site specific.

5.1.5 Water Quality

5.1.5.1 Construction Phase

During the construction period, water will be used from nearby river and streams. Therefore, there is possibility of water pollution especially where lines cross rivers and streams and where the tower pads are situated where run-off can enter a stream or river. Soil disturbances associated with construction of tower pads, the improper disposal of solid wastes and materials such as cement slurry, construction materials, and human wastes may cause temporary deterioration of water quality. There is a potential for water borne diseases in adjacent villages where flowing streams are used for household chores. The impact is expected to be moderate in magnitude, site specific and for a short duration.

5.1.5.2 Operation Phase

The operation and maintenance activities of the transmission lines will not impact water quality. Domestic wastes from substations may impact surface and groundwater. Potential impacts are limited in magnitude and extent, but are long-term.

5.2 Biological Environment

5.2.1 Vegetation/Forest Resources

5.2.1.1 Construction Phase

Impacts on ground flora and fauna accrue form clearing vegetation in the ROW, specifically for the tower pads and footings, and at substation sites. ROW selection will avoid forested areas to the extent possible. The total footprint of ROW and new substations is about 1,880 ha.[99] The 25 km segment from Manang to Khud includes 2 new substations with a total footprint of 135 ha, which is about 7% of the total project footprint. In terms of area / geographic extent, the overall magnitude of impact on vegetation is considered to be low, and impacts are largely short-term and reversible, as vegetation will be allowed to re-grow in the ROW.

Clearance of ROW

During the construction period almost all the trees having more than 10 cm diameter-at-breast-height (dbh) will be cleared for the construction and erection of the transmission tower. Based on review of proposed routes, available survey reports, topographic maps, satellite imagery, and site reconnaissance, about 126 ha of forested area will be affected by the project, which is about 6.7% of the total project footprint. The total number of trees will be determined during preparation of IEEs and EIA for the individual transmission lines.

Harvesting of Non-Timber Forest Products (NTFP)

The proposed project does not directly affect the NTFPs of the project vicinity and no impact is envisaged for NTFP. The project areas are generally not rich in valuable NTFP and the magnitude of impact is considerable to be low. Extent is local and duration is short term.

[99] For purposes of environmental assessment, this assumes 9 substations with 5 ha per substation, and 399 km of transmission ROW with a width of 46 meters. The actual footprint is expected to be smaller, as the ROW for 220 kV lines is only 30 meters.

Increase in Demand for Fuel Wood and Timber
Skilled, unskilled and semi skilled labor will be involved in the construction of the project. Most of the labor force will come from the project areas, but there will be some people employed during construction from outside the project area for short period to time. Potential increase in demand of fuel wood and timber during the construction period is expected to be low. Moreover, there will be no permanent settlements leading to encroachment on forest land. The impact is be considered to be low in magnitude, site specific and short termed.

5.2.1.2 Operation Phase

Clearance of ROW
Vegetation in the ROW will be allowed to re-grow while still maintaining compatible clearance with conductors for safe operation. The trees will be trimmed every 3-4 years to maintain the required vertical and horizontal clearances. ROW clearance will not only change the vegetation cover but also will alter the ecological condition to some extent.

However, the overall operation phase impact on vegetation will be low because once the ROW is cleared, frequent trimming and felling is not required. The extent is site specific and duration is long term.

Increased Access to Forest
The clearance of 30 m ROW in the forest land may provide easy access to local people for the intrusion of forest and its products. The magnitude of impact is considered to be low because most of the forest in the project area belongs to community, or is leasehold forest which is managed by the community forest user groups. Furthermore, strict rule and regulation and monitoring by the user groups will also control the unnecessary encroachment. This activity will not have a noticeable effect on the forest and vegetation.

5.2.2 Disturbance to Wildlife
5.2.2.1 Construction Phase
The degree of impact on wild animals depends entirely on the species present, vegetation type and abundance of food. Possible impacts on wildlife population due to the project construction will be minimized by careful routing.

Loss of Habitat
Impact on wildlife habitat is related to loss of vegetation due to ROW clearing and substation construction. As noted above, the project footprint is about 1880 ha, of which less than 7% is forested. Comparing the forested area to be cleared to the total footprint, the magnitude of impact is considered to be low, extent is site-specific, and duration is long term (see further discussion on biodiversity below).

Avian hazards
Overhead transmission lines constitute a persistent threat to birds given the height (typically up to 45 m above ground) and the fact that conductors are thin and difficult for birds to detect and avoid. Impact on avian fauna is expected to be high in low visibility conditions, especially bad weather and night time, but it is very difficult to quantify the risks. Except for areas within a few kilometers of Important Bird Areas (discussed in section 4), the magnitude of impact is expected to be low, extent is site specific and duration is long time.

Hunting and poaching by Labor Force
Hunting and poaching is a possibility due to the presence of construction workers. The possibility of hunting and trapping by workers during construction period will be site-specific and will decrease once the work is completed. The overall magnitude of impact is considered to be low, extent is site specific and duration is short period.

Overall Impacts on Biodiversity

Impacts on biodiversity have been assessed by mapping the proposed transmission routes with respect to (i) protected areas and other potentially sensitive habitats, (ii) habitat ranges (as shown in Appendix X), (iii) forested areas, and (iv) land use zoning in the ACA; the various figures in Section 4 and the Appendices present these aspects of the assessment. Reconnaissance inspections have been conducted in June and December 2013 and March 2014, and preliminary and detailed route surveys have also been reviewed. The IEE which has been completed for the Markichowk-Kathmandu line has also been reviewed.

This assessment process has identified 3 "hot spots" where the habitat ranges of sensitive species are intersected by the proposed transmission routes, as summarized in Table 5.1. Mitigation options are also presented in Table 5.1. This assessment will be updated as the IEEs and EIA for individual transmission lines are prepared pursuant to Nepali regulatory requirements, with mitigation options updated accordingly.

Table 5.1: Potentially Sensitive Locations, Impacts, and Mitigation Options

Location	Sensitive species & Habitat Range	Potential Impacts	Mitigation Options
Khudi-Manang segment in ACA (25 km, 220 kV)	Clouded Leopard between 1500 to 3000 m, but preferred habitat is above 2000m	Potential disruption of migration pathways, breeding and/or hibernation areas at higher elevations of transmission line	• 220 kV ➔ not 400 kV • Reforestation @ 25:1 • Minimize RoW width with stacked conductor array • Allow re-vegetation to grow 1-2 meters high in ROW • Implement reforestation as a biodiversity offset?
	Snow leopard between 3000 to 4500 m	No direct impacts	• No specific measures required • Additional assessment will be conducted and mitigation options identified if necessary in EIA for the Khudi-Manang transmission line
	Himalaya musk deer 2500 m and higher	No direct impacts	
	Himalaya wood mouse 2400 to 3500 m	No direct impacts	
Dovan "bottleneck" (~ 1.8 km)	Tiger	Disruption of migration paths due to ROW clearing	• Reforestation @ 25:1 • Allow re-vegetation to grow up to 1 – 2 meters high, facilitating migration • Implement reforestation as a biodiversity offset?
Samundratar - Trishuli 132kV Line: Gerkhu VDC Segment	Assamese Monkey		
	Leopard Cat		

ROW = right of way, VDC = village development committee
Note: Findings are preliminary and will be updated.

5.2.2.2 Operations Phase

Biodiversity impacts during operations are minimal, as the affected areas will return to a state of equilibrium as vegetation re-grows in the ROW. The impacts during operations are site-specific, but long-term. Further evaluation will be made by the IEEs and EIA conducted for the sensitive areas noted in Table 5.1 above. The impacts during operations will be concentrated to some extent in the ACA, as it was established for biodiversity conservation. The impacts can be envisioned by a comparison of the project footprint relative to other infrastructure in the ACA and relative to the total area of the ACA as summarized below in

Table 5.2

Table 5.2: Summary of Existing Infrastructure and Project Footprint in the ACA

Infrastructure	Footprint in ACA
Existing Roads – 2 lane, unimproved	446 km x 15 m = 669 ha
Existing Housing & other buildings	18,680 households x 400 m^2 per household = 747.2 ha
2 substations and assumed transmission right-of-way (ROW) in conservation area	25 km x 50 m = 125 ha + 10 ha = 135 ha total
Relative transmission footprint (ROW / total housing and roads)	135 / 1416.2= 9.53 %
Relative transmission footprint (ROW / total conservation area)	135 / 762,900 = 0.018 %

ACA = Annapurna Conservation Area, ha = hectare, ROW = right of way

5.3 Socio-economic and Cultural Environment

The key impacts arise from land acquisition, resettlement, social and cultural problems due to influx of labors, and economic spin-offs. Specifics of land acquisition and resettlement are covered in the resettlement and indigenous peoples plans for the project, which are stand-alone documents. The following discussion is therefore limited to general socio-economic and cultural impacts.

5.3.1 Health, water supply and sanitation

5.3.1.1 Construction Phase

Project area residents may experience some regular contact with the temporary labor force including outsiders. The temporary work force, especially temporary construction camps (if needed), may add further stress on the local health and sanitation situation. Communicable gastro-intestinal diseases such as diarrhea, dysentery, paratyphoid, worm as well as respiratory diseases, infection and haphazard discharge of wastes of various types including metals, paper, kitchen wastes etc., have the potential to degrade the sanitary hygienic conditions around construction areas and campsites. Non-resident experts, technicians, and laborers from outside the project area may add additional pressure on local health and sanitation situation. The concentration of labor force may encourage prostitution which poses potential for spread of HIV/AIDS and other sexually transmitted disease. However, considering the small number of labors, typically about 25 people per crew, and short term presence at any given site the potential impacts are considered to be low, site specific and for short term.

Similarly, with the increase in temporary population along with the construction activities, will place additional demand on drinking water and existing sanitation facilities. The potential impacts on water supply and sanitary situation will be: shortage of drinking water, increase pressure on the existing water supply system, increase distance to the safe drinking water, increase in disease vectors, and reduced water quality due to increased sanitation problems etc. However, given the size of construction crews relative to local communities, the impact on water supply and sanitation will be low, short term and site specific.

The lack of proper sanitary measures and increase in wastes and water pollution may lead to the outbreak of epidemic diseases such as Jaundice, typhoid etc. Since, the local people will

be employed as skilled, semi-skilled and labor to the extent possible, such impact is considered to be of moderate nature in magnitude, short–term and localized.

5.3.1.2 Operation Phase

No impacts are anticipated during the operation phase. After construction, the only increase in population will be the small labor force required for substation operations, which will be sourced from the project area to the maximum extent possible.

5.3.2 Occupational Hazards and Safety

5.3.2.1 Construction Phase

Work related injuries and vehicle accidents can be expected during the construction period. The magnitude of impact is low the extent is site specific and the duration is short termed.

5.3.2.2 Operation Phase

Nearby residents will be vulnerable to electrical hazards, including shocks, fires, or even electrocution. The public can be affected principally through their own activities, such as attempting to climb transmission towers. Alteration of road alignments could allow large vehicles to pass closer to the ROW that desired, and illegal construction of buildings in the ROW pose similar hazards. These risks should have very low probability of occurrence, but are of great significance to individuals involved. The overall magnitude of impacts is considered to be low, extent is local and duration is long term.

5.3.3 Electric and Magnetic Field Effect

5.3.3.1 Construction Phase

Impacts during construction are not expected. Potential impacts arise only after the transmission lines and substations are energized.

5.3.3.2 Operation Phase

Electric power transmission lines create electric and magnetic field together, referred to as electromagnetic fields (EMF). EMFs are created by the presence of voltage and are expressed in volts per meter (V/m), while magnetic field is produced by the present of current in the line and is expressed in terms of ampere per meter (A/m). EMFs are strongest beneath the lines and diminish rapidly with distance. Electrical field strength declines in inverse proportion to the square of the distance and magnetic field strength decreases in inverse proportion to the cube of the distance.[100] Research on the long-term effects of EMF associated with transmission line is inconclusive with respect to health risks.

Electric field of high voltage line gives rise to corona effect causing ionization leading to the generation of ozone and oxides of nitrogen, possible radio and television interference and audible noise at high levels. Such noise will increase under rain and smog conditions. The magnitude of overall impact is considered to be low, extent is local and duration is long termed.

5.3.4 Religious, Historical and Archeological Site

5.3.4.1 Construction Phase

Temples are quite common in Nepal and the project areas are no exception. Route surveys and ground reconnaissance conclude that one temple on the Markichowk-Kathmandu line and one temple on the Samundratar-Trishuli 3B line are close to the proposed ROW. These 2 temples and any others will be avoided by re-routing as necessary, which will be determined by NEA field supervision teams and construction contractors. No other historical and archeological sites have been noted to date; additional on-ground reconnaissance will be

[100] E.g., at a distance of 10 meters from a single transmission line or conductor, electrical field strength drops to 1% of the field strength at the conductor: 1/(10*10) = 1%. Likewise, the magnetic field strength drops to 0.1% of the field strength at the conductor: 1/(10*10*10) = 0.1%.

conducted as part of IEEs and EIA for the individual lines. The potential impacts are moderate (given that temples are quite common), site-specific, and long term.

5.3.4.2 Operation Phase
No impact is expected during the operation phase.

5.3.5 Law and Order Due to Religious Differences
5.3.5.1 Construction Phase
During the construction of the transmission line labor from different places with different religion and faiths will be employed by the contractor and there will be possibilities of conflict of interest thus affecting the law and order situation. The past experiences reveal that local people have misunderstanding with the employer's and contractor's staff. Since the project is of small scale and local labor will be employed for construction activities, the likely impact on law and order situation due to project is low in magnitude, local and short termed.

5.3.5.2 Operation Phase
No significant impacts are expected during this phase.

5.3.9 Aesthetic Impacts
5.3.9.1 Construction Phase
Impacts are expected to be minimal and short term during construction.

5.3.9.2 Operation Phase
Impacts to visual resources are examined in terms of changes between the existing landscape character and proposed actions, sensitivity of viewing points available to the general public, their viewing distances and visibility of proposed changes.

Field reconnaissance notes that existing 11 kV, 33 kV, and 132 KV power lines and telephone towers are located in the vicinity of proposed transmission corridors. Stringing of overhead lines with towers up to 45m high will cause visual changes to the existing landscape and scenery. The steel structures are large and prominent and will give negative impact on the visual character of the flat agricultural land, but are much less visible in hilly terrain. As most of the proposed ROW is in hilly areas, overall impact is considered to be moderate, and site-specific, but long term.

5.4 Beneficial Impacts

5.4.1 Local Employment
Local employment during the construction phase will be beneficial, but temporary. Each of the four transmission lines is expected to require deployment of about 200 workers during construction; of this, 100 will be unskilled, 75 will be semi-skilled, and 25 skilled laborers. Such employment opportunities to some extent may check out-migration of the project area and promote in-migration. In this regard, the employment opportunities are expected to contribute to poverty alleviation. The magnitude of impact is considered to be moderate, extent is local, and duration is short term.

5.4.2 Local Economy
Employment opportunities, income from shop keepers, housing rental, increased demand for fresh vegetables, meat and rental/lease of land, etc. are possible sources of income during construction. Increased trade and business will inject significant cash into local economies. This short term economic gains will contribute to the development of local economy. The increase in business will enhance the economic status of local people. Project area residents will have opportunities to sell agricultural products including livestock to the construction related workforce and project personnel with significant benefit to local farmers in terms of cash economy. The magnitude of impact is considered to be moderate, extent is local and

duration is medium term.

5.4.3 National/Regional Economy

The proposed transmission lines will be able to evacuate up to 2000 MW of new generation capacity in the Central and Western Development Regions of Nepal. The associated hydropower plants under construction now total about 145 MW, which will provide clean energy supplies sufficient for the minimum electricity needs of at least 1,000,000 people, with avoided greenhouse gas (GHG) emissions of 400,000 tons carbon dioxide equivalent per year[101]. Improved power supplies are expected to promote urbanization in the project corridors and support new industrial development.

5.5 Mitigation Measures

Table 5.3 summarizes potential impacts and mitigation options. At the design stage, potential impacts are mitigated by careful routing to avoid sensitive ecosystems such as forests and wetlands, steep terrain, and populated areas to the maximum extent possible. The proposed project will utilize high-temperature / low-sag (HTLS) conductors which have about twice the capacity of conventional conductors but have approximately the same weight. The section from Kushma to Butwal was initially proposed to be 400 kV rated line, and some consideration has been given to 400 kV lines in the entire Marsyangdi Corridor; use of HTLS conductors allows 220 kV voltage with a narrower ROW (only 30 m vs. 46 m, or 35% less area than conventional design). The technical analyses conducted for the project determined that all of the 220 kV lines could utilize HTLS conductors as an optimum solution except for the Butwal-Bardaghat segment which will be 400 kV with conventional conductors; this will avoid the need for 400 kV lines in the Marsyangdi corridor, including the Khudi-Manang section in the ACA.

In ecologically sensitive areas which cannot be avoided, the transmission ROW can be narrowed by using “stacked” conductors, as shown in Figure 5.3. A double circuit transmission line has 2 sets of 3 wires for each circuit, normally strung on each side of the transmission tower as shown above in Figure 5.2. Figure 5.3 shows how the 2 sets of 3 wires can be arrayed vertically to narrow the effective ROW, or to increase capacity without increasing the ROW width.

5.5.1 Soil Erosion and Loss of Vegetation

The majority of the ROW is within a few kilometers of existing roads and tracks. Temporary access tracks are not expected to be needed. Soil erosion and silt runoff will be minimal as excavation is required only for tower footings. Erosion control measures such as dikes and retaining walls will be constructed as necessary to ensure tower footings are stable; this will also minimize soil erosion and runoff. Drainage controls will also be included in substation design.

The ROW will be acquired prior to construction and the affected people will be compensated. Clear felling will be limited to 5 m in forested areas. Trimming of vegetation for routine maintenance will be conducted on an annual or as-needed basis after construction. Minor damage to crops may be unavoidable, and any crop damage will be compensated as per the existing rules. The lines will cross a total of about 138 ha of forested area (assuming a 46 m ROW); the rest of the ROW is mostly cultivated land. New trees will be planted to offset those removed during construction. Replanting will be at a ratio of 25:1. Additional offset activities are discussed below in Section 5.5.8.

[101] The assumptions are: (i) new clean energy capacity is 100 MW increasing to 1000 MW, running 4000 hours per year; (ii) electricity consumption of 400 kilowatt-hours per year per person (0.4 MWh/person/year); and (iii) clean energy displaces diesel-fired generation with an emissions factor of 1 ton carbon dioxide equivalent per megawatt-hour.

Table 5.3: Potential Impacts and Mitigation Measures for Overall Project

Parameter	Activity / Potential Impacts	Nature	Magnitude	Extent	Duration	Mitigation Measures
Potential Impact on Physical and Biological Environment: Design and Construction Phases						
Topography, land use, and biota	Clearing of transmission right-of-way (ROW): improved access may increased stress on wildlife and sensitive species; possible increase in poaching	D	H	SS	LT	Routing to minimize disturbance of vegetation. Consider stacked conductor design in forested areas and sensitive ecosystems (see Figure 5.3). Access restrictions to be included in contract specifications and construction plans. Construction contracts to include provisions for worker awareness, anti-poaching, and supply alternate fuels. Clear felling to be limited to 5 meters. Reforestation at 25:1 and/or other offset activities as agreed with protected areas management.
	Visual impairment of landscape	D	M	SS	LT	Routing to avoid inhabited areas and popular tourist and trekking areas to the extent possible and practical. Use low-visual impact tower and substation design.
Noise and vibration	Construction equipment >70 dB(A) at project site	D	L	SS	ST	Equipment to meet national noise standards; personal protective gear to be provided to construction workers. Restrictions on night-time operations in populated areas
	Noise from transmission lines and associated substations	D	M	SS	LT	Locate substations 70–100 m from nearest receptor if possible; greenbelt to provide partial noise barrier if necessary to limit noise to 55 dB(A) at nearest receptor or 3 dB(A) above background. Tower height and right-of-way width will ensure that corona noise is minimized to nearest receptors.
Water quality	Soil erosion and wastewater from work sites and construction camps: Suspended solids, BOD, and fecal coliform contamination	D	M	SS	ST	Run-on / run-off control including retention ponds, silt traps, and other treatment if needed Construction staging areas and camps to be located outside of ecologically sensitive areas, except as necessary (e.g., in ACA) Recycling and disposal of solid wastes, including composting of biodegradable wastes Primary treatment of domestic wastewater if needed.

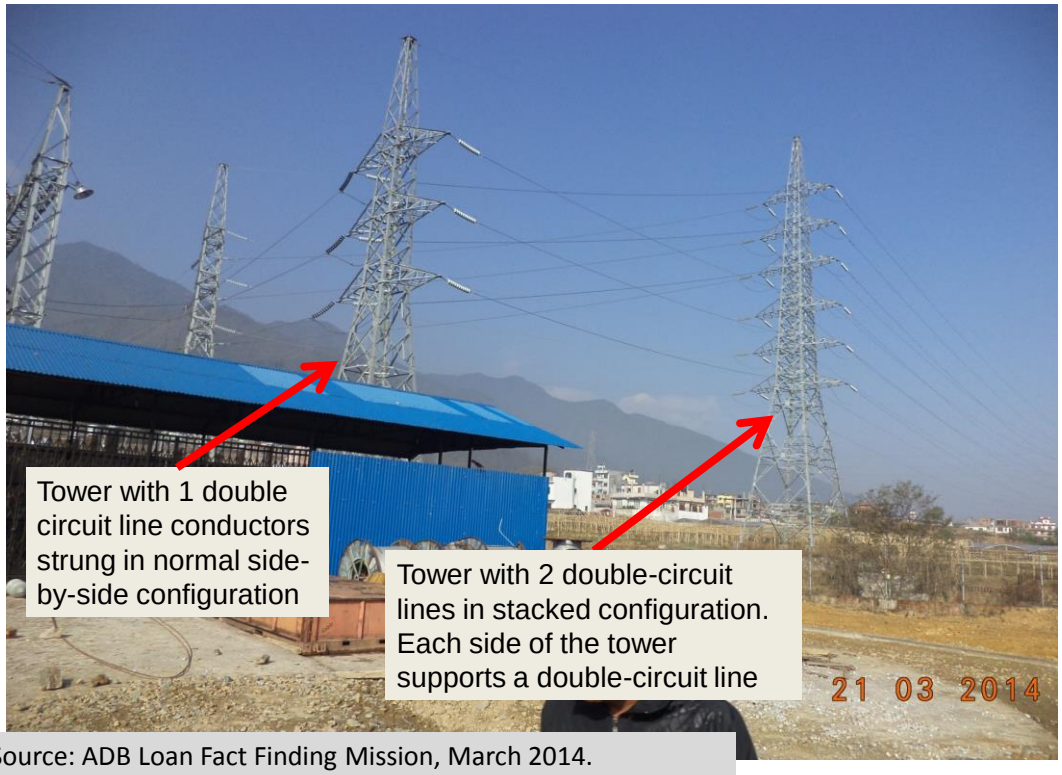
Parameter	Activity / Potential Impacts	Nature	Magnitude	Extent	Duration	Mitigation Measures
Waste generation	Wastewater, waste lubricants, and minor fuel spills: Petroleum and detergent contamination	D	L	SS	ST	Construction staging areas and camps to be located outside of ecologically sensitive areas, except as necessary (e.g., in ACA) Recycling and disposal of solid wastes. Composting of biodegradable wastes Primary treatment of domestic wastewater if needed.
-Air quality	Construction dust and exhaust gases: increased SPM, NO_2, SO_2 levels at construction sites, and surrounding areas	D	L	SS	ST	Dust control with water sprays. Contractor's equipment to meet national equipment and vehicle emissions standards
Physical and cultural resources	Disturbance of houses, public buildings, and temples	D	L	SS	ST	Avoid via careful routing of transmission lines and siting of substation.
Potential Impact on Physical and Biological Environment: Operation Phase						
Topography, land use, and biota	Maintaining transmission right-of-way (ROW) – vegetation control	D	L	SS	LT	Allow vegetation to grow to 1-2 meters high in ROW to allow free movement of wildlife in sensitive areas at Manang-Khudi line, Dovan bottleneck in Kaligandaki corridor, and Gerkhu VDC in Samundratar-Trushuli 3B hub corridor.
Noise and vibration	Noise from transmission lines and associated substations	D	M	SS	LT	Maintain greenbelt and other noise barriers as necessary to limit noise to 55 dB(A) at nearest receptor or 3 dB(A) above background. Tower height and right-of-way width will ensure that corona noise is minimized to nearest receptors.
Water quality	Domestic wastewater from substations	D	L	SS	LT	Primary treatment of domestic wastewater (septic tanks)

Parameter	Activity / Potential Impacts	Nature	Magnitude	Extent	Duration	Mitigation Measures
Waste generation	Used equipment and domestic solid wastes from substations	D	L	SS	ST	Secure on-site storage, or off-site disposal at licensed facility if necessary. Used equipment may be refurbished and reused at other sites if possible. Scrap metal may be sold into recycling markets. Biodegradable waste to be composted on site. Non-degradable waste disposed off-site at approved facilities.
Air quality	Increased SPM, NO_2, SO_2 levels at construction sites, and surrounding areas	D	L	SS	ST	Emissions will be limited to routine vehicle traffic in and out of substations.
Physical and cultural resources	No ongoing impacts after construction	IN	L	SS	ST	Local government units will ensure that squatters do not take up residence in ROW or encroach upon substations.
Greenhouse gas emissions	Minor GHG releases to atmosphere from fire suppression equipment. including from equipment using CFCs and halons (e.g. fire suppression systems):	D	L	SS	LT	Specify non-CFC and non-halon equipment; dispose in accordance with GoN standards.

BOD = biochemical oxygen demand, CFC=chlorofluorocarbons, dB(A) = decibel acoustic, NEA = Nepal Electricity Authority, NO_2 = nitrogen dioxide, NO_x = nitrogen oxides, PMU = Project Implementation Unit, ROW=right-of-way, SO_2 = sulfur dioxide, SPM = suspended particulate matter.

Notes: Nature: D=direct, IN=indirect, R=reversible, IR=irreversible
Magnitude: H=high, M=medium, L=low
Extent: SS=site-specific, L=local, R=regional
Duration: LT=long-term, MT=medium term, ST=short-term

Figure 5.3: "Stacked" Conductors at Matatirtha Substation



Source: ADB Loan Fact Finding Mission, March 2014.

Precautionary measures focused on the protection of vegetation and wildlife are essential while working in all of the forest areas, particularly during the construction stages. Unnecessary felling of the trees and use of old trees for firewood by the workforce should be discouraged during the construction. RoW vegetation clearance should be done manually and herbicides will not be used in any case. Trimming of vegetation will be limited to the ROW and temporary access roads, which will be minimized. No vegetation outside the ROW will be disturbed. Cleared vegetation may be taken by community forest users for local use. Forest rehabilitation will be conducted under Ministry of Forests and Soil Conservation procedures for compensation, with 25:1 replanting ratio. The EMP includes monitoring provisions to confirm the replanting activities are documented.

5.5.2 Air and Noise

Air and noise pollution will be avoided by minimizing use of heavy machinery during construction. Construction will generate air and noise emissions for a short duration in predominantly rural locations, and is considered insignificant. Construction contractors will be required to deploy equipment which meets Nepali air and noise control standards. Construction will occur primarily during daytime hours for safety considerations.

5.5.3 Waste Management

Any used equipment and other construction wastes will be disposed of following the best practices and the local rules. Health hazards from potential explosions or fire, electric shocks, and accidents to staff and the public will be minimized through implementation of measures including (i) designs using appropriate technologies to

minimize hazards, (ii) safety awareness raising for construction and operational staff and the public, (iii) substations equipped with modern fire control systems, (iv) provision of adequate water supply and sanitation facilities for substations and construction camps, (v) provision of adequate staff training in operations and maintenance, and (vi) security fences and barriers around substations and transmission towers in populated areas and in the proximity of public places such as schools.

5.5.4 Mitigation at Substation Sites

The new substations will be located on unused land or agricultural land, which will be cleared of crops prior to construction. Substation construction will require some earthmoving to prepare the sites for buildings and equipment installation. Erosion control measures will be incorporated into substation design in accordance with site conditions. Run-on and run-off controls will be built-in to maintain integrity of building and equipment foundations, and avoid run-off of potentially contaminated water.

Air and noise pollution will be avoided by minimizing use of heavy machinery during construction. Temporary nuisance to the residents and pedestrians during movement of the equipment and materials for substation components such as transformers may be unavoidable, and will be minimized by informing affected people in advance of construction, and requiring contractors to implement noise abatement measures. Construction activities will be restricted during the nighttime.

Due to the relatively small area required for the substations, the impact on air quality will be limited and localized. Water sprays will be used as necessary for dust suppression. Contractors' equipment will be required to meet Nepal air and noise control standards.

5.5.5 Flora and Fauna

A ban on poaching of birds and animals in the areas adjacent to the transmission ROW will be enforced during construction.[198] Kerosene or other alternate fuels will be provided to construction camps so that workers will not need to gather wood for cooking. Construction contractors will provide information briefings to the workforce as well as regular spot checks to enforce restrictions on poaching and gathering of firewood. The construction work in community forest areas will be coordinated through DFO and CFUGS, respectively.

As discussed in Section 4, regional mapping by IUCN and ICIMOD indicates that potentially endangered species may be found over large portions of Nepal. Construction may be restricted during breeding and migration seasons, if warranted. The EMP includes provision for reforestation to offset potential impacts on sensitive ecosystems. There are various programs and projects being implemented in Nepal which will partially offset potential impacts on sensitive species including those in the ACA; these programs are discussed below (Section 5.5.8) and summarized in Appendix 3.

5.5.6 Monitoring and Oversight

Monitoring and oversight are included in the EMP, which is discussed in Section 7. Construction contractors will prepare and implement environmental, health, and safety

[198] In other parts of Nepal, hunting and poaching does not appear to be a major issue. For example, the EIA summary for the Tamakoshi 3 hydropower project noted that hunting and poaching is not common and no obvious signs of such activity were observed during the EIA surveys; hunting is banned in the community forests. SWECO Norge AS. 2009. *Tamakoshi 3 Hydroelectricity Project, Executive Summary – Volume XI, Document for Disclosure, Final Report – November 30, 2009*. Oslo, Norway.

plans. Implementation consultants will conduct periodic inspections of construction sites and will conduct air, noise, and waste monitoring as necessary.

5.5.7 Greenhouse Gas Emissions Scenarios

GHG emissions scenarios are discussed in the context of cumulative and induced impacts in Section 5.6. Net GHG emissions resulting from the project are expected to be negative as the transmission line will connect a major new clean energy source to the grid.

5.5.8 Offset of Potential Impacts in Sensitive Habitats

The EMP includes revegetation and reforestation to offset potential impacts related to clearing and maintaining ROW (the EMP is presented in Section 7). Based on the reconnaissance visits, available data, and assessment conducted to date, the project will not impinge directly on critical or natural habitats: about 25 km of ROW and 2 new substations will be located in the "intensive use" zone of the ACA (see Figure 4.32); review of all available documents on the area indicate that the substations sites and ROW will not impact critical or natural habitats. Therefore, a biodiversity offset specific to flora and fauna in the ACA is not considered to be necessary, but a generic offset will be achieved through tree replacement at a ratio of 25 new trees for each tree removed (25:1) in the ACA and at 2:1 in other areas.[199] Wildlife movement can be facilitated by allowing vegetation to grow to a height of 1-2 meters in the ROW; this may require increasing transmission tower height in some instances (see Table 5.1 above). The project will result in increased clean energy supplies and increased access to energy, which will reduce pressure on forests for fuelwood.

The National Rural Renewable Energy Program (NRREP) led by the Nepal Alternative Energy Promotion Center (AEPC) is implementing a broader clean energy program targeting areas with reliance on fuelwood and other traditional biomass. The RE-based mini grid component cofinanced by the Scaling Up Renewable Energy Program (SREP) has been developed under the aegis of the NRREP. Also under the NRREP and the SREP Investment Plan for Nepal, ADB's Private Sector Operations Department is developing a small hydropower investment program which is expected to be approved by ADB's Board in 2014. Various other hydropower projects are under development by the private sector. The status of compliance with relevant provisions of ADB environment safeguards is summarized in Table 5.4.

Ongoing Activities Which Indirectly Offset Impacts of the Project

There are numerous donor-funded activities in Nepal promoting and supporting protected areas and forest management, preservation of biodiversity and cultural diversity, capacity building for adaptation to climate change and for climate resilient development, community-scale renewable energy development, institutional development for reducing emissions from deforestation and degradation (REDD+), and capacity building for payment for ecosystems services (PES). Donor agencies, special funds, and other partners include ADB, the European Union, the Global Environment Facility (GEF), IUCN, the Pilot Program for Climate Resilience (PPCR), the program for Scaling Up Renewable Energy Program in Low-income Countries (SREP), and several bilateral programs (Finland, Germany, Japan, Norway, United Kingdom, and the United States). See Appendix 3 for further information on off-setting activities.

[199] NEA will commission an EIA specifically for the Manang-Khudi transmission components as required by Nepali regulations; this EIA may identify additional biodiversity protection measures if necessary. The line is scheduled to be completed by mid-2019, with a maximum construction period of 2 years, allowing more than 2 years for the EIA to be completed.

Table 5.4: Compliance with ADB requirements for Sensitive Habitats

ADB Safeguard Provision [a]	Degree of Impact
Critical Habitats Do not implement project activities unless: (i) There are no measurable adverse impacts on the critical habitat that could impair its ability to function (ii) There is no reduction in the population of any recognized endangered or critically endangered species (iii) Any lesser impacts are mitigated	Review of habitat maps and ranges indicate that the project facilities and right-of-way will have minimal or no direct impact on critical habitats. Small size of project "footprint" will result in no quantifiable adverse impacts on sensitive species in the project area. Potential impacts due to clearing of vegetation will be offset by reforestation activities included in the EMP, and other offsetting activities.
Legally Protected Areas Implement additional programs to promote and enhance the conservation aims of the protected area.	Parts of the transmission infrastructure and some associated hydropower facilities are located in the ACA, a multiple-use conservation area which allows large-scale infrastructure development (see Table 5.2). Prospects for additional programs in the ACA will be evaluated as part of the Manang-Khudi transmission line EIA.
Natural Habitats There must be no significant conversion or degradation, unless: (i) Alternatives are not available (ii) The overall benefits of the project substantially outweigh the environmental costs (iii) Any conversion or degradation is appropriately mitigated	The project facilities and right-of-way will impinge on natural habitats, but the area is limited to less than 150 hectares of forested land. There are no viable alternatives to the project based on technical, environmental, economic, and social considerations. Potential environmental costs of the project are minimal and will be offset by reforestation, benefits of the project, and benefits accruing from various other ecological preservation activities (see Appendix 3).
Notes: [a] ADB *Safeguard Policy Statement 2009*, page 16, Environmental Safeguards, Policy Principle number 8.	

5.6 Cumulative and Induced Impacts

Suppressed power demand due to economic growth is inducing the Project rather than *vice versa*. Consumers rely on expensive diesel and gasoline (petrol) generators for back-up power, and new transmission capacity is necessary to alleviate the power demand-supply imbalance. The direct impacts are minimal, as discussed above. Various hydropower plants that will be connected to the transmission lines are associated facilities (see Table 3.3). "Downstream" of the transmission line, the demand centers in the main project corridors, the Kathmandu Valley, other cities, and future consumers in India, are beneficiaries of the transmission system expansion and

as such are an "associated facility."

EIAs are required for the associated hydropower plants by Nepali regulations, and must include EMPs with mitigation measures specific to the project areas. The hydropower plants currently under construction have completed EIAs, and have received the necessary environmental clearances including no objection from the parent Ministry over the ACA. The major impacts from associated hydropower plants are changes in river flow, disruption of sediment transport, and disturbance of fish migration. The impacts are difficult to quantify as existing hydropower plants have impacted the environment. For example, the 70 MW Middle Marysangdi project is a run-of-river design with minimal reservoir area; the diversion structure (just upstream of the proposed Udipur substation site) extends across the river channel and does not include fish ladder or other fish passage features. There is an existing hydropower plant on the Kali Gandaki river in the vicinity of Jomsom, about 30 km upstream of the associated 42 MW Mristi Khola project. All of the associated facilities are run-of-river designs, with minimal reservoir areas; clearing of vegetation including any forested areas will be minimal compared to storage-type hydropower with equivalent power capacity.

The associated hydropower plants under construction have rated aggregate capacity of about 145 MW[200] and the design output is estimated to be 635,100 MWh per year (assuming 50% plant load factor). The GHG emissions offset is calculated assuming a factor of 1.08 tons carbon dioxide equivalent per megawatt-hour (tCO_2e / MWh) of electricity produced by diesel generator sets.[201] The GHG offset is estimated to be 685,908 million tCO_2e per year, which will result in a net emissions reduction for the project as shown in Table 5.5.

Table 5.5: Estimated Greenhouse Gas Balance

Facility	**Capacity (MW)**	**Annual Output @ 50% PLF (MWh)**	**GHG Offset @ 1.08 tCO_2e/MWh**
associated HPPs	145	635,100	685,908
New Cement Plants	**Capacity (t/y)**	**GHG Emissions**	**Net GHG Emissions**
1 ton cement/ 1 MWh	635,100	317,550	- 368,358

CO_2e = carbon dioxide equivalent, GHG = greenhouse gas, HPPs = hydropower plants, MW = megawatts, MWh = megawatt-hours, PLF = plant load factor, t = tons

Evaluating induced impacts in the Kathmandu urban area and other demand centers is decidedly complicated. As noted above, economic growth has resulted in suppressed power demand throughout Nepal and in neighboring India. The transmission lines will facilitate bridging the demand-supply gap and will reduce the need for back up diesel generators. In the long term, the expanded power capacity and transmission grid will be facilitating economic growth, but managing economic development for sustainability --

[200] The Kaligandaki and Marsyangdi basins each have at least 1000 MW of hydropower potential which is considered to be technically and economically feasible. There are various hydropower projects in the development queue but the total capacity permitted and expected to be completed within the next 3 - 5 years is only 103 MW in these 2 corridors, of which 2 projects account for 92 MW: the 50 MW Upper Marsyangdi project on the Marsyangdi River and the 42 MW Mristi Khola project on the Kaligandaki. An additional 42 MW aggregate capacity is to be connected to the Samundratar-Trishuli 3B Hub corridor.

[201] This emissions factor includes black carbon, and is used for the ADB PSOD mini-grids proposal for Clean Technology Fund cofinancing (in progress).

especially urban growth -- is well beyond the control of the NEA.

Rather than attempting a comprehensive assessment of “downstream” impacts, a proxy assessment can be made. Urban growth relies on construction materials such as asphalt for roads, and cement and steel for buildings. Of these materials, cement is produced in Nepal while asphalt and steel are mainly imported; cement plants are a major potential consumer of energy. Cement production is therefore taken as a proxy for downstream impacts. Cement production consumes 3 to 6 gigajoules (GJ) of fuel per ton of cement produced. Assuming that Nepali cement plants are highly efficient, energy consumption is assumed to be 3.6 GJ per ton of cement; 3.6 GJ is equivalent to 1 MWh. If all of the electricity from the associated facilities were to be used for cement production, the production capacity would be about 635,100 tons cement per year.

GHG emissions from cement production are estimated to be 0.9 tons CO_2e per ton of cement produced, of which 50% is from the production process and about 40% is from fuel consumption. [Energy consumption and emissions factors were accessed on 25 April 2011 from: http://en.wikipedia.org/wiki/Cement]. Assuming that hydroelectricity is the fuel (instead of coal), the GHG emissions factor is taken as 0.5 tCO_2e per ton of cement. Table 5.5 shows that the net GHG emissions would be negative, i.e. there would be a net reduction.

The cumulative impacts from economic development will ultimately depend on implementation of sustainable transport systems, rational zoning and land use management, solid waste management, wastewater treatment, and promotion of green buildings (new and retrofit).

6. Information Disclosure, Consultation, and Participation

6.1 Information Disclosure

The initial draft of this IEE was disclosed on ADB's website in the last week of February 2014. Revised drafts will be posted as they become available. NEA will disclose IEEs and EIAs for the individual transmission lines in accordance with Nepali and ADB requirements.

6.2 Consultation and Participation

The citizens of Nepal are painfully aware of the need for additional electric power investments. About 44% of the population has no access to electricity and a majority of the population still relies on traditional biomass for energy needs. Load shedding of 12 hours per day or more directly impacts consumers who are connected to the electricity grid. Power shortages have grown more severe during the past several years, a fact which is widely known throughout the country. In effect, it is highly unlikely that people who are potentially affected by the project are not aware of the poor state of commercial energy services in Nepal in general and in the project area in particular.

NEA conducts informal consultations as part of its route surveys, and formal consultation during preparation of environmental assessments (IEEs and EIAs). Most of the transmission routes were identified with surveys conducted during 2010 – 2012, and are being or have been surveyed again for the proposed Project. The Manang-Khudi route was originally surveyed in 2010 when it was conceived as a 132 kV line; the route is being surveyed again for the proposed 220 kV line[202]; potentially affected people along the ROW route have been informally consulted twice. As required under the Nepali regulatory framework, a detailed environmental assessment which includes public consultations will be conducted for the Manang-Khudi section (this section is scheduled for completion by June 2019, and with a 2-year construction schedule, there is ample time to complete the necessary IEE or EIA including extensive consultation with potentially affected people); environmental assessments will be prepared for other transmission sections as well.

The surveys being conducted for land acquisition and resettlement planning include consultation with directly affected people; the main environmental and social impacts arise from ROW clearing and substation construction, and social surveys therefore serve the purposed of consultation on potential environmental impacts. Documentation of these surveys is included in Appendix 5. As most of the proposed transmission lines have been subject to 2 route surveys, a detailed social survey to develop land acquisition and resettlement plans, and a detailed environmental assessment, potentially affected people will have been consulted 3 or 4 times prior to construction.

The various hydropower projects in the transmission corridors are also required to conduct stakeholder outreach and consultation: it is possible that some potentially affected people will have been informed on 5 separate occasions about the power system expansion projects prior to construction of the transmission system components. Residents in the project areas are familiar with the need for transmission system expansion and other infrastructure, and generally support the proposed project components.

NEA has consulted with the ACA on the need for the Manang-Khudi 220 kV line which will be located in the ACA. The ACA management team is aware of the need for transmission infrastructure, as there are several proposed hydropower projects located

[202] The change in design to 220 kV was based on technical considerations.

inside the ACA, at least 2 of which have completed EIAs and received “no objection” from the Ministry of Forests.

6.3 Grievance Redress Mechanism

NEA has an existing procedure to receive inquiries and complaints about project related activities (developed for other ADB projects), as well as responding to such inquiries and complaints. Feedback from potentially affected people will be used to establish a grievance redress mechanism (GRM) appropriate to the expected level of impacts.

The ADB *Safeguard Policy Statement 2009*, Appendix 1, paragraph 20, clearly notes that GRM is the responsibility of the borrower:

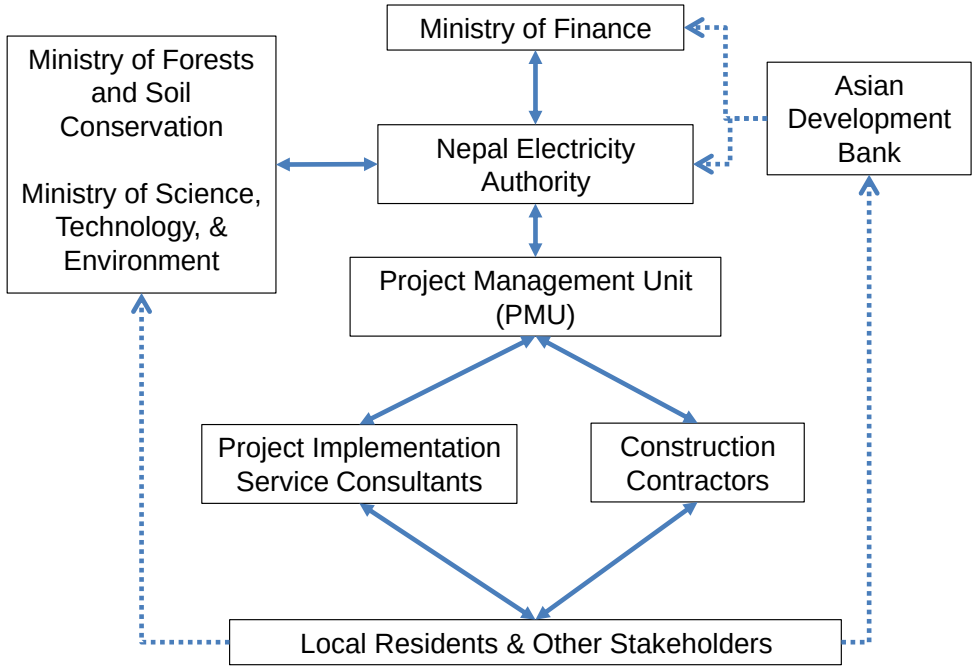
> The borrower/client will establish a mechanism to receive and facilitate resolution of affected people’s concerns, complaints, and grievances about the project’s environmental performance. The grievance mechanism should be scaled to the risks and adverse impacts of the project. It should address affected people’s concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people at no costs and without retribution. The mechanism should not impede access to the country’s judicial or administrative remedies. The affected people will be appropriately informed about the mechanism.

In the context of the proposed Project, there are potential language and other communication barriers. Potentially affected people may have mobile phones, radios, and televisions, but may not have ready access to internet.

Consultation of potentially affected people is still being undertaken for the Project, and there is a need for a sustained effort to address any concerns and complaints. The general information flow for registering and responding to concerns and complaints is illustrated in Figure 6.1. During construction, concerns and complaints would be brought to the attention of the construction contractors, project implementation services consultants, PMU, NEA, Ministry of Finance, and ultimately to ADB if necessary. During operations, concerns and complaints shall initially be brought to the attention of NEA representatives in project area.

Most complaints and concerns should be resolvable at the local level (i.e., in the project area). For those instances where this is not the case, an appeals committee could be included as part of the GRM as an appropriate forum for complaint resolution. The PMU will coordinate the further elucidation of a GRM for the Project, which should be in effect prior to commencement of construction.

Figure 6.1: GRM Complaint Flow



7. Environmental Management Program

Key issues to be addressed by the EMP are :

- Clearance of ROW: determination of potential impacts on sensitive habitats and potentialy endangered species; and advance notice to affected communities
- Cleared vegetation can be utilized by Community Forest User Groups (CFUGs); however, no burning of vegetation in construction areas is allowed
- Construction schedule may be restricted if deemed necessary during migration season of sensitive species
- Construction contractors will implement corporate EH & S programs
- Implementation consultants will support monitoring and inspection activities, with support from other third-party service providers as necessary
- Provisions for reforestation are included to offset clearing of vegetation in the transmission ROW

The EMP has been developed as part of the environmental assessment to avoid, minimize, and mitigate potential negative impacts of the Project. The EMP comprises routine environmental monitoring to support proactive mitigation of any potential impacts from construction and operations. The EMP includes the following:

(i) proposed management and mitigation activities (Table 7.1)
(ii) proposed monitoring plan and parameters (Table 7.2)
(iii) description of responsibilities and authorities for mitigation and monitoring, reporting, and review
(iv) preliminary work program (Table 7.3), and
(v) preliminary cost estimates (Table 7.4)

7.1 Proposed Management and Mitigation Measures

The purpose of the EMP is to guide the pre-construction, construction, and operational periods of the project as per Nepali and ADB environmental requirements. The EMP will be updated during the project design and implementation stages as necessary based on field conditions, construction contractor performance, and stakeholder feedback.

Table 7.1 presents the EMP for the overall project, covering 3 stages: (i) Pre-construction, (ii) construction, and (iii) operations and maintenance. The EMP is dynamic and will be updated and modified as necessary and appropriate based on contractor performance and monitoring results. Modifications to the EMP will be made by the NEA PMU and included in the twice-yearly progress reports submitted to ADB, or more frequently if necessary. Compensatory afforestation and reforestation is possibly the most significant activity of the EMP. After the detailed route surveys are completed, a Compensatory Planting Plan and Slope Stabilization Plan will be prepared in consultation with the Ministry of Forest and Soil Conservation and relevant District Forest Office. Criteria for afforestation and reforestation should be defined in terms of retaining and improving biodiversity and ecosystem connectivity, and logically should be concentrated in the ACA and Dovan Bottleneck to complement on-going biodiversity conservation activities there.

In the pre-construction stage NEA is required to prepare IEEs and EIAs with EMPs for the individual transmission lines rather than for the overall project (as discussed in other sections of this IEE; see Figure 2.1). The IEE for the Markichowk-Kathmandu line has

been completed, but the IEEs for other lines have not been completed as of April 2014.

During the construction stage, the EMPs for the individual projects are the most important documents for use by NEA, project implementation consultants, and construction contractors. The EMP summarized in Table 7.1 is by necessity preliminary in nature, and is intended to be guide project implementation, with the individual EMPs taking precedence as they are completed.

7.2 Proposed Monitoring Plan

Transmission systems and associated hydropower plants substations do not emit conventional pollutants, except for emissions from construction activities, used equipment and materials, and domestic wastes from substations. The associated hydropower plants are all run of river design with minimal storage capacity. Potential methane emissions will be non-existent or minimal compared to storage-type designs. Potential spills of fuel, lubricating oils, and transformer oils would be localized and unlikey to result in detectable pollution of surface waters. The conventional pollutant monitoring proposed in Table 7.2 will be of value primarily for establishing baseline conditions in the project area, and then for ambient quality monitoring.

Table 7.2 presents recommended provisions for baseline ecological and environmental monitoring. Monitoring activities may be modified during implementation depending on contractor performance and analytical results. If field inspections, monitoring, and analyses indicate good environmental performance, then successive monitoring intensity and frequency may be reduced. Conversely, if environmental performance is worse than expected, corrective measures will be identified and monitoring activities will be adjusted accordingly to resolve any problems.

7.3 Work Program

The preliminary work program for the first 3 years of implementation is summarized in Table 7.3. EMP related work will begin in early 2014. Procurement support will begin by mid-2104 and design review activity will begin in fourth quarter of 2014. Construction is not expected to commence until 2015 at the earliest. Any additional baseline and other survey and assessment work that may be required can be completed before construction commences. Clearing of vegetation and re-vegetation/reforestation activities are expected to be conducted outside of the monsoon season, pending recommendations of the IEEs and EIA for individual transmission lines.

Table 7.1: Preliminary Environmental Management Plan

Project Activity	Environmental Issues	Management / Mitigation Measures	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Pre-construction Phase				
Regulatory clearance and permitting	Impact on potentially sensitive ecosystems: potential loss of productive agriculture and forest products, and potential loss of habitat and ecological value	Letter from National Planning Commission to indicate if the ADB-funded activities comprise a National Priority Project. Permitting for clearance of Right-of-way (ROW) prior to construction: (i) Advance notice and no objection from residents; (ii) Compensation arrangements for loss of cash crops (10-year valuation on fruit trees; current market value for timber and other crops); (iii) Permissions and letter agreements from relevant District Forest Office, Community Forest User Groups (CFUGs), and if necessary from Department of National Parks and Wildlife Conservation; and (iv) Prepare Compensatory Planting Plan and Slope Stabilization Plan with Ministry of Forest and Soil Conservation and District Forest Office. ROW demarcation and detailed survey: (i) Delineate ROW via survey; (ii) Consultation with potentially affected residents and CFUGs within 1 kilometer of ROW; (iii) Marking of trees to be cut, avoiding areas where “hollows” provide living space for sensitive wildlife; and (iv) Confirm locations for compensatory planting at least one month before commencing the construction work. ***NEA to commission IEEs for individual transmission lines in coordination with detailed route surveys with EMPs available by the time of contract tendering from 2014 onwards.*** *EIA for Manang-Khudi transmission line to be completed by Q4 2016*	NEA / PMU to obtain letter, if necessary, from National Planning Commission NEA / PMU in consultation with Ministry of Forest and Soil Conservation, District Forest Offices, Department of National Parks and Wildlife Conservation District Forest Office to provide confirmation of tree marking and proposed compensatory planting areas IEEs and EIA by ESSD/3rd party services	“No objection” from ADB prior to contract tender and awards Annapurna Conservation Area manangement chief to issue No Objection Certificate for Manang-Khudi transmission subproject

Table 7.1: Preliminary Environmental Management Plan (continued)

Project Activity	Environmental Issues	Management / Mitigation Measures	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Pre-construction Phase (continued)				
Transmission design and construction plan: (i) Selection of construction staging areas, equipment maintenance, waste management procedures, and access controls; (ii) Baseline monitoring	Components in ACA and any other ecologically sensitive areas Potential pollution from air, noise, and hazardous materials during construction and operations Safety during construction and operations	Transmission towers and lines to include high-visibility markers such as bird flight diverters in environmentally sensitive areas. Consider "stacked" conductor design to minimize right-of-way (ROW) in ecologically sensitive areas (see Figure 5.3). Include adequate erosion control for tower footings, especially in steep terrain. Increase tower height if necessary to allow for 1-2 meter revegetation beneath lines. Route lines around cultural heritage sites. Ensure adequate setbacks from inhabited areas for substations and other facilities as necessary. Construction equipment to meet national air and noise emissions standards. Construction contract to include provision for waste management including possible industrial hazardous wastes. Contractors to prepare and implement corporate EHS plan. Contractors to have established corporate environmental, health, and safety (EHS) program; ISO 14001 certification or equivalent is desired. Prior to clearing of ROW and other construction activities, conduct at least one round of pre-construction baseline monitoring for conventional pollutants (air, noise, and water) as outlined in Table 7.2	NEA / Design team Project Implementation Consultants (or ESSD) to conduct monitoring with third party services as necessary PPTA consultants to update list of offsetting activities	"No objection" from ADB prior to contract tender and awards
Qualification and selection of construction contractors	Environmental, health, and safety performance of construction contractors	Construction contracts to include provisions for corporate EHS program and/or ISO 14001. Special conditions of contract may include incentives and penalties for inadequate environmental performance.	NEA / PMU to include appropriate provisions in bidding documents and contracts	

Table 7.1: Preliminary Environmental Management Plan (continued)

Project Activity	Environmental Issues	Management / Mitigation Measures	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Construction Phase				
Physical construction: manual labor and mechanized construction	Worker / operator safety (noise, vibration) Equipment wear and tear Traffic management	Construction techniques and machinery selection to minimize noise and vibration. Noise to be limited to 55 dB(A) at site boundaries or 3 dB(A) above background. Construction equipment to be maintained in accordance with national standards for noise exposure to workers. Air, dust, noise, vibration, and water quality monitoring at least 2 times per year in ACA and any other protected areas, and at least 1 time per year in other areas. Results to be included in semi-annual Safeguards Monitoring Report. Any required road improvements will include drainage and erosion control measures and will be designed to minimize disturbance to normal traffic flows.	Construction Contractors will implement corporate EHS plan. Project Implementation Consultants (or ESSD) to conduct monitoring and inspections utilizing 3rd-party services as necessary	PMU to conduct periodic spot checks to confirm compliance. ADB review Missions
Health and safety	Injury and sickness of workers and members of the public Potential BOD and fecal coliform contamination	Construction camps to be located outside of sensitive ecosystem areas. Any camps will include proper sanitation, water supply, and waste disposal facilities, including primary treatment for domestic sewage and secure disposal of domestic solid wastes. Contractor to prepare and implement a health and safety plan including worker training and daily/weekly briefings. Contractors to give “tool box” talks on environmental issues and to enforce anti-poaching and other environmental protection provisions.		
Construction equipment maintenance	Wastewater from maintenance may cause soil and water contamination	Construction equipment staging and maintenance areas to be located outside of environmentally sensitive areas. Construction contractor to provide wastewater containment, and sedimentation and biological treatment, if necessary.		

Table 7.1: Preliminary Environmental Management Plan (continued)

Project Activity	Environmental Issues	Management / Mitigation Measures	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Construction Phase (continued)				
Ambient air quality and noise nuisance	Dust, exhaust, and noise emissions from construction equipment	Controlled construction activities and maintenance of machinery, timely scheduling of construction activities to avoid nuisance to sensitive ecosystems (and nearby communities). Construction equipment to meet national emissions and noise control standards. Water sprays to be used for dust control as necessary.	Construction contractors to implement EHS plan Project Implementation Consultants (or ESSD) to conduct monitoring and routine inspections	NEA / PMU ADB review missions
Storage of chemicals and any hazardous materials	Possible spills resulting in contamination of soil, water, and air	Fuel, lubricants, and any other hazardous materials will be staged outside of protected areas to the maximum extent possible, and will be securely stored to prevent spills. Contractors to provide spill response kit in accordance with Material Safety Data Sheets for chemicals and hazardous materials		
Construction waste management	Air, soil, and water pollution due to inadequate management and control	Construction wastes to be managed in accordance with national standards and best practices. Soil, rock, and other spoils to be used in run-off control structures to maximum extent practical. Waste lubricating oils to be disposed or recycled off-site by licensed service companies. Contractors' EHS plans to include contingency provisions for testing of polychlorinated biphenyls (PCBs) if any transformers are to be decommissioned; if necessary, arrange for secure storage at substation sites or controlled off-site disposal at licensed facilities.		

Table 7.1: Preliminary Environmental Management Plan (continued)

Project Activity	Environmental Issues	Management / Mitigation Measures	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Construction Phase (continued)				
Construction stage environmental monitoring	Inadequate/unsafe working conditions Environmental impairment at protected areas and other project sites	Appropriate contact clauses to ensure satisfactory implementation of contractual environmental, health, and safety measures. Implementation of environmental monitoring and reporting system using checklist of all contractual environmental requirements.	PMU	NEA, ADB
		Implement ambient air, noise, and water monitoring program as outlined in Table 7.1	Project Implementation Consultants (or ESSD)	NEA / PMU
Biodiversity protection and improvement	Preservation of sensitive habitats	Clearing of vegetation in transmission ROW should be minimized, e.g., cutting vegetation low to ground while preserving root structure rather than complete removal. Transmission towers and lines to include high-visibility markers such as bird flight diverters in environmentally sensitive areas. Reforestation as per Nepali and ADB requirements: implement Compensatory Planting Plan and Slope Stabilization Plan with Ministry of Forest and Soil Conservation and District Forest Office. Update list of offsetting activities on an annual basis.	Project Implementation Consultants (or ESSD)	NEA / Ministry of Forest and Soil Conservation ADB

Table 7.1: Preliminary Environmental Management Plan (continued)

Project Activity	Environmental Issues	Management / Mitigation Measures	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Operation and Maintenance Phase				
Routine operations and maintenance	Potential loss of vegetation and habitat in protected areas	Maintain warning / advisory signs in good condition Visual inspection of annual vegetation trimming in transmission right-of-way	PMU and Project Implementation Consultants (or ESSD)	NEA, Ministry of Environment ADB Review Missions
Periodic air, noise, and water quality monitoring at sensitive areas	Maintain EHS program to prevent pollutant emissions via source controls	Monitoring results to be reviewed by NEA and ADB to confirm that mitigation measures are adequately controlling pollution at the source and preventing ecosystem deterioration. Pollutant source monitoring parameters and frequency may be modified if results show no degradation. Evidence of degradation would trigger operational review to determine need for improved control measures.	PMU and Project Implementation Consultants (or ESSD)	NEA ADB Review Missions
Biodiversity protection and improvement	Preserve and improve ecosystem integrity	Biodiversity offset management and annual habitat / biodiversity surveys to be conducted if deemed necessary.		

Table 7.2: Minimum Provisions for Environmental Monitoring

Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
Pre-construction Stage				
Air: PM, NOx, SOx Noise: dB(A) Water: pH, BOD / COD, suspended solids, fecal coliform	Up to 5 locations around project area to be identified by NEA / ESSD	"Grab" samples for air and water Spot check for noise and dust using portable monitoring devices	Air, noise, and water sampling and analyses: at least 1 event prior to start of construction.	PMU supported by Implementation Consultants and other third-party services NEA / PMU to include EMP in bidding documents; ADB to verify requirements in bidding documents.
Construction Stage				
Clearing / cutting vegetation and offsetting areas for afforestation and reforestion Air, Noise, and Water: same parameters as in pre-construction stage Construction wastes: on-site inspection	Forested areas of ROW and afforestation / reforestation sites 5 stations around project area (same as during construction) Visual inspection of active construction areas, including equipment staging areas and camps	Field inspection of vegetation clearing and reforestation to ensure that appropriate measures are implemented "Grab" samples for air and water Spot check for noise and dust using portable monitoring device Spot check / visual inspection of solid waste generation and disposal. Analysis of transformer oils to determine if polychlorinated biphenyls are present.	Vegetation clearing and reforestation: quarterly during construction period Air, noise, and water: quarterly during construction period Monthly spot checks for construction waste management	Contractors to implement corporate EHS plan, including wastewater and solid waste control. EMP Implementation consultants to conduct pollutant source emissions monitoring, and inspect wastewater and solid waste controls. PMU staff to provide oversight via regular field inspections, and submit semi-annual Safeguards Monitoring Report. ADB to audit during project review missions.

Table 7.2: Minimum Provisions for Environmental Monitoring (continued)

Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
Operations and Maintenance Stage				
Reforestation monitoring	Reforestation sites agreed with NEA and other stakeholders	Spot checks based on visual inspections and any complaints	Twice-yearly surveys	NEA / PMU ADB to audit during project review missions

ADB = Asian Development Bank, BOD = biochemical oxygen demand, DO = dissolved oxygen, ESSD = Environment and Social Services Department of NEA, NEA = Nepal Electricity Authority, PMU = project Implementation unit, SPM = suspended particulate matter, TSS = total suspended solids

Table 7.3: EMP Work Plan – Key Activities

Activity	2015				2016				2017			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Preparation of IEEs / EIA for individual lines												
IEE for Kali Gandaki: Dana-Kushma-Butwal 220 kV	X	X	X	X								
IEE for Marsyangdi: Khudi-Bharatpur 220 kV	X	X	X	X								
IEE for Kali Gandaki: Butwal-Bardaghat 400 kV	X	X	X	X								
EIA for Manang-Khudi 220 kV	X	X	X	X	X	X	X	X				
Monitoring Activities												
Visual inspections beginning with contractor mobilization -- monthly or more frequently by PMU / ESSD / consultants	X	X	X	X	X	X	X	X	X	X	X	X
Air, Noise, Water, and Solid Waste Management – monitoring by Implementation Consultants	X	X	X	X	X	X	X	X	X	X	X	X
Vegetation removal (outside of monsoon season); PMU / ESSD quarterly inspections				X	X	X		X	X	X		
Reforestation / Offset Program												
Afforestation / Reforestation / Other offset activities (outside of monsoon season)		X		X	X	X		X	X	X		
Quarterly disbursements and twice-yearly monitoring reports		X		X	X	X		X	X	X		

IEE = initial environmental examination, EIA = environmental impact assessment, ESSD = Environmental and Social Safeguards Department of NEA, NEA = Nepali Electricity Authority, PIC = project implementation consultants, PMU = project implementation unit of NEA

7.4 Responsibilities for Mitigation, Monitoring, Reporting, and Review

NEA/PMU

The existing Project Coordination Office will be upgraded to a Project Management Unit (PMU) within a Project Management Directorate (PMD) at NEA. The PMU includes officers responsible for environmental and social safeguards implementation. The PMU is responsible for the ongoing ADB-funded projects covering transmission system expansion and upgrade, energy efficiency and renewable energy development.

The PMU will ensure that bidding documents include criteria for EHS policy and environmental certification criteria as noted. Special conditions of contract may include penalties and incentives for environmental performance. The PMU will prepare monitoring reports 2 times per year and submit these reports to ADB. The PMU will prepare environmental management reports every 6 months during construction and annually through the first year of operations. The reports will cover EMP implementation with attention to compliance and any needed corrective actions. Additional public consultation will be conducted as necessary during construction. The PMU is in the process of updating its website to provide for public disclosure and public comments.

NEA/ESSD

NEA will have primary responsibility for completing the IEE as per Nepali regulatory requirements and for implementing the EMP. NEA will engage ESSD and/or other third-party firm as necessary to update and complete the EIA, IEEs and implement the EMPs. ESSD will conduct routine inspections of construction activities, including visual survey of ROW clearance, construction equipment staging areas, and construction camps. ESSD will take initial responsibility for the ambient environmental monitoring, including procurement and delivery of monitoring equipment, and conducting routine emissions monitoring during construction and operations. The scope of work is outlined below:

(i) Review construction contractors EHS plan, and recommended revisions as necessary;
(ii) Conduct environmental monitoring and analyses (air, dust, noise, vibration, and water quality) twice yearly and at least once prior to commencement of construction; conduct visual inspections of construction areas at least twice yearly and more frequently if deemed necessary;
(iii) Assist PMU in preparation and delivery of Safeguards Monitoring Report two times per year.

Construction Contractors

Construction contractors will be required to have a corporate environmental, health, and safety (EHS) policy, and environmental management certifications such as ISO 14001 (or equivalent). Contractors will have primary responsibility for worker health and safety at construction sites and camps. This includes provision of appropriate personal protective equipment (e.g., hard hats, safety boots, and hearing protection), provision of sanitation facilities, and controlled management and disposal of construction, domestic, and sanitary waste facilities.

Asian Development Bank

ADB will (i) review and endorse the IEE/EIA and EMP before contracts are finalized and construction commences; (ii) review monitoring reports; and (iii) officially disclose environmental safeguards documents on its Web site as necessary in accordance with the ADB *Public Communications Policy* (2005).

7.5 EMP Cost Estimates

Preliminary cost estimates for the EMP are shown in Table 7.4. These estimates cover the basic monitoring activities for a 3-year implementation period and are subject to revision. Costs for revegetation / reforestation will be estimated in the IEEs and EIA for individual transmission lines. The basic EMP cost will be funded by the Project or from government counterpart funds.

Table 7.4: Preliminary EMP Cost Estimates (to be revised)

Activity	Unit	Unit Cost ($)	Total ($)
A. Routine Environmental Monitoring			
Contractor EHS Review by Implementation consultants	LS	10,000	10,000
Air, Dust, Noise, & Water Monitoring & Construction EHS Inspections – Equipment	LS	25,000	25,000
Implementation Consultants – International Professional for Monitoring [assumes 2 visits per year, 2 p-m per year x 3 years]	6 p-m	20,000	120,000
International Consultants – Travel (2 RT airfare/year @ $5000/RT; 60days per diem/year @ $150/day; + miscellaneous costs)	LS / year	20,000	60,000
Implementation consultants – National Professionals Remuneration for Monitoring and Visual Inspections (1 full-time equivalent, 3 years)	36 p-m	2,500	90,000
National Consultants – travel and per diem (local travel @ 250 / month x 36 months; local per diem 600 days total @ $50 / day plus miscellaneous costs)	LS	40,000	40,000
Subtotal			***345,000***
Contingencies	LS	55,000	55,000
TOTAL			**400,000**

Source: TA 8272-NEP consultant estimates.

7.6 Additional Assessment and IEE/EMP Update

As discussed above, the EMP is a dynamic document and will be updated going forward. Of particular importance are the IEEs and EIA for the individual transmission lines prepared under the Nepali regulatory framework. These will be completed during the next 2-3 years. NEA will have overall responsibility for ensuring that these assessments are completed in a timely manner, and ADB will retain its supervisory role as discussed above.

8. Conclusions and Recommendations

8.1 Key Findings

The Project has potential environmental sensitivity as the transmission lines will support various associated hydropower facilities, including some which are located in the Annapurna Conservation Area. The proposed Project comprises clearing of right-of-way, construction of new transmission towers and substations, rehabilitation of grid substations, and electrification within transmission corridors. Disturbance during construction will arise from clearing of vegetation, equipment staging, construction of substations, erection of transmission towers, and stringing of conductors on the towers.

The potential footprint in the ACA is less than 0.018% of the total area of the ACA; the potential impacts of the project on the ACA will be difficult if not impossible to monitor in a quantitative manner. The proposed Khudi-Manang transmission line will be in the “intensive” land use zone which is not host to critical or natural habitat. If necessary, the ROW can be minimized in sensitive areas by use of stacked conductors (stacked conductors have been utilized in the Kathmandu urban area).

Negative environmental impacts accruing from the Project will be minimal, short-term, and reversible, and can be readily mitigated. Issues of land acquisition and resettlement of households will have some negative impacts on socio-economic resources. Most of these negative impacts will occur during the construction phase. During the operational stage minimum effects will occur and these too can be minimized with appropriate provisions in the Environmental Management Plan (EMP). There are also several positive effects such as reduced emission of greenhouse gases which will in fact aid in the efforts made for conservation of environmental resources. NEA will have the overall responsibility of the EMP implementation.

The potential impacts will occur primarily during construction and are minimal, temporary, and reversible. Longer term impacts result from establishing the transmission right-of-way and new substations. Adequate compensation arrangements will be made for necessary land acquisition.

The potential impacts on the ACA and other potentially sensitive sites are expected to be minimal and can be readily mitigated. The transmission footprint will be minimized by use of advanced HTLS conductors which allows for 220 kV design instead of 400 kV for most of the proposed lines. Revegetation will be conducted to mitigate the impacts of clearing the ROW. Any negative environmental impacts will be offset via support to the Annapurna Conservation Area and multiple other donor-assisted activities directed toward climate-resilient development.

Key Issues Relevant to Environment Category

The proposed Manang-Khudi transmission segment and substations are in the "intensive" landuse zone of the ACA. The intensive landuse zones are supporting human and infrastructure development, so that the more sensitive ecosystems -- mostly at higher elevations -- can be preserved. Review of detailed information on sensitive species habitats and ranges indicates that the critical habitat is minimal and will not be directly impacted by the project. Natural habitat is present in the form of forested areas which will be avoided to the maximum extent possible; less than 150 ha of forest clearance will be required which will be offset by reforestation at 25:1.

The various "landscapes" such as Chitwan Annapurna Landscape (CHAL) and Terai Arc Landscape (TAL) are not legally protected areas. CHAL and TAL are formal designations for conservation initiatives, but there is no documentation that the areas which may be crossed by transmission lines are critical or natural habitats. These landscapes are similar to buffer zones which complement the legally protected areas, but the various landscapes are not legally protected areas or legally defined buffer zones. The CHAL is home to 4.5 million

people, including the city of Pokhara and all of the Pokhara Valley, and covers almost all of the proposed transmission routes.

Researchers note that tigers specifically disperse through sugar cane fields in northern India. The sugar cane fields are a "tall grasslands" analogy. Potential impacts on tiger and other ground-dwelling fauna in the various landscapes can be mitigated by allowing vegetation to grow to a height of 1 - 2 meters in the ROW. If necessary the transmission towers can be made higher than normal, and stacked conductor design might also be used.

Community forest management may be more effective at preserving biodiversity and sensitive flora and fauna that establishing new protected areas. To put this in context, since 1987, total protected areas in or partly covered by the CHAL (which covers most or all of the project area) have expanded from about 200,000 hectares to more than 1,240,000 hectares -- more than 562% -- but there is no obvious correlation between expansion of protected areas with improvement in biodiversity conservation.

Given the nature of transmission systems, there are limited mitigation measures available (as discussed in section 5 and summarized in Table 5.2 above). Conducting a full EIA will not result in identification of any new mitigation options. If a biodiversity offset is deemed necessary, additional environmental surveys can be conducted as necessary and an offset program can be developed prior to construction; in effect, the required re-vegetation can be implemented as a biodiversity offset if necessary. Construction in the ACA is not expected to begin until 2017, so there is ample time to develop an offset program. As noted in Section 2, the Nepali regulatory requires that NEA commission an EIA for the transmission line and substations in the ACA. The EIA for the Manang-Khudi line will identify the need for special bio-diversity conservation measures if necessary, and the required re-vegetation activity could be designed accordingly. Based on the investigation and assessment conducted to date, ADB environment category B was proposed and confirmed by ADB's environmental and social safeguards division in March 2014.

8.2 Conclusions and Recommendations

The proposed Project is the best alternative with respect to economic, environmental, financial, and social criteria. Potential negative environmental impacts can be mitigated by implementation of the EMP. As discussed in Section 7, the EMP will be updated and revised as necessary to ensure that environmental and ecological objectives in the project area are met.

The environmental assessment to date complies with ADB and Nepali policy and guidance for energy sector projects, and is sufficient to allow the Project to proceed to ADB Board consideration. Appropriate assurances should be incorporated into loan and project agreements to ensure that the EIA and EMP are updated as necessary and fully implemented.

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Appendix 1: Important Flora and Fauna
Table 1: List of Bird Species found in Annapurna Conservation Area
Annapurna Conservation Area
Central coordinates 84° 0.00' East 28° 32.00' North
Area 762,900 ha

Species	Season	Population estimate	IBA Criteria	IUCN Category
Snow Partridge *Lerwa lerwa*	resident	present [units unknown]	A3	Least Concern
Tibetan Snowcock *Tetraogallus tibetanus*	resident	frequent [units unknown]	A3	Least Concern
Himalayan Snowcock *Tetraogallus himalayensis*	resident	present [units unknown]	A3	Least Concern
Tibetan Partridge *Perdix hodgsoniae*	resident	present [units unknown]	A3	Least Concern
Hill Partridge *Arborophila torqueola*	resident	frequent [units unknown]	A3	Least Concern
Rufous-throated Partridge *Arborophila rufogularis*	resident	rare [units unknown]	A3	Least Concern
Blood Pheasant *Ithaginis cruentus*	resident	frequent [units unknown]	A3	Least Concern
Satyr Tragopan *Tragopan satyra*	resident	uncommon [units unknown]	A1	Near Threatened
Koklass Pheasant *Pucrasia macrolopha*	resident	frequent [units unknown]	A3	Least Concern
Himalayan Monal *Lophophorus impejanus*	resident	frequent [units unknown]	A3	Least Concern
Cheer Pheasant *Catreus wallichi*	resident	frequent [units unknown]	A1, A2	Vulnerable
Ferruginous Duck *Aythya nyroca*	passage	uncommon [units unknown]	A1	Near Threatened
Lesser Kestrel *Falco naumanni*	passage	uncommon [units unknown]	A1	Least Concern
Pallas's Fish-eagle *Haliaeetus leucoryphus*	passage	rare [units unknown]	A1	Vulnerable
White-rumped Vulture *Gyps bengalensis*	resident	rare [units unknown]	A1	Critically Endangered
Slender-billed Vulture *Gyps tenuirostris*	breeding	rare [units unknown]	A1	Critically Endangered
Himalayan Vulture *Gyps himalayensis*	resident	common [units unknown]	A3	Least Concern
Red-headed Vulture *Sarcogyps calvus*	resident	rare [units unknown]	A1	Critically Endangered
Cinereous Vulture *Aegypius monachus*	winter	rare [units unknown]	A1	Near Threatened
Pallid Harrier *Circus macrourus*	passage	rare [units unknown]	A1	Near Threatened
Greater Spotted Eagle *Aquila clanga*	passage	frequent [units unknown]	A1	Vulnerable
Eastern Imperial Eagle *Aquila heliaca*	passage	rare [units unknown]	A1	Vulnerable
Ibisbill *Ibidorhyncha struthersii*	unknown	present [units unknown]	A3	Least Concern
Wood Snipe *Gallinago nemoricola*	breeding	rare [units unknown]	A1, A3	Vulnerable
Snow Pigeon *Columba leuconota*	unknown	present [units unknown]	A3	Least Concern
Speckled Wood-pigeon *Columba hodgsonii*	resident	uncommon [units unknown]	A3	Least Concern
Slaty-headed Parakeet *Psittacula himalayana*	resident	common [units unknown]	A3	Least Concern
Asian Emerald Cuckoo *Chrysococcyx maculatus*	unknown	unknown [units unknown]	A3	Least Concern
Golden-throated Barbet *Megalaima franklinii*	resident	uncommon [units	A3	Least Concern

Species	Season	Population estimate	IBA Criteria	IUCN Category
		unknown]		
Blue-throated Barbet *Megalaima asiatica*	resident	frequent [units unknown]	A3	Least Concern
Yellow-rumped Honeyguide *Indicator xanthonotus*	resident	uncommon [units unknown]	A3	Near Threatened
Darjeeling Woodpecker *Dendrocopos darjellensis*	resident	frequent [units unknown]	A3	Least Concern
Bay Woodpecker *Blythipicus pyrrhotis*	resident	rare [units unknown]	A3	Least Concern
Black-winged Cuckooshrike *Coracina melaschistos*	unknown	unknown [units unknown]	A3	Least Concern
Short-billed Minivet *Pericrocotus brevirostris*	resident	rare [units unknown]	A3	Least Concern
Grey-backed Shrike *Lanius tephronotus*	resident	frequent [units unknown]	A3	Least Concern
Maroon Oriole *Oriolus traillii*	resident	frequent [units unknown]	A3	Least Concern
Black-headed Jay *Garrulus lanceolatus*	resident	uncommon [units unknown]	A3	Least Concern
Gold-billed Magpie *Urocissa flavirostris*	resident	common [units unknown]	A3	Least Concern
Grey Treepie *Dendrocitta formosae*	resident	common [units unknown]	A3	Least Concern
Yellow-billed Chough *Pyrrhocorax graculus*	resident	common [units unknown]	A3	Least Concern
Dark-grey Tit *Parus rufonuchalis*	resident	uncommon [units unknown]	A3	Least Concern
Rufous-vented Tit *Parus rubidiventris*	resident	common [units unknown]	A3	Least Concern
Coal Tit *Parus ater*	resident	common [units unknown]	A3	Least Concern
Grey-crested Tit *Parus dichrous*	resident	common [units unknown]	A3	Least Concern
Green-backed Tit *Parus monticolus*	resident	common [units unknown]	A3	Least Concern
Yellow-browed Tit *Sylviparus modestus*	resident	common [units unknown]	A3	Least Concern
Nepal House-martin *Delichon nipalense*	resident	frequent [units unknown]	A3	Least Concern
Black-throated Tit *Aegithalos concinnus*	resident	common [units unknown]	A3	Least Concern
White-throated Tit *Aegithalos niveogularis*	winter	rare [units unknown]	A2	Least Concern
Black-browed Tit *Aegithalos iouschistos*	resident	uncommon [units unknown]	A3	Least Concern
White-browed Tit-warbler *Leptopoecile sophiae*	resident	uncommon [units unknown]	A3	Least Concern
Striated Prinia *Prinia crinigera*	resident	common [units unknown]	A3	Least Concern
Striated Bulbul *Pycnonotus striatus*	resident	uncommon [units unknown]	A3	Least Concern
Himalayan Bulbul *Pycnonotus leucogenys*	resident	common [units unknown]	A3	Least Concern
Mountain Bulbul *Hypsipetes mcclellandii*	resident	frequent [units unknown]	A3	Least Concern
Asian Black Bulbul *Hypsipetes leucocephalus*	resident	common [units unknown]	A3	Least Concern
Chestnut-headed Tesia *Tesia castaneocoronata*	resident	frequent [units unknown]	A3	Least Concern
Grey-bellied Tesia *Tesia cyaniventer*	resident	uncommon [units unknown]	A3	Least Concern
Chestnut-crowned Bush-warbler *Cettia major*	breeding	rare [units unknown]	A3	Least Concern

Species	Season	Population estimate	IBA Criteria	IUCN Category
Aberrant Bush-warbler *Cettia flavolivacea*	resident	common [units unknown]	A3	Least Concern
Hume's Bush-warbler *Cettia brunnescens*	breeding	rare [units unknown]	A3	Least Concern
Grey-sided Bush-warbler *Cettia brunnifrons*	resident	common [units unknown]	A3	Least Concern
Smoky Warbler *Phylloscopus fuligiventer*	breeding	rare [units unknown]	A3	Least Concern
Tickell's Leaf-warbler *Phylloscopus affinis*	resident	frequent [units unknown]	A3	Least Concern
Sulphur-bellied Warbler *Phylloscopus griseolus*	unknown	present [units unknown]	A3	Least Concern
Buff-barred Warbler *Phylloscopus pulcher*	resident	common [units unknown]	A3	Least Concern
Ashy-throated Warbler *Phylloscopus maculipennis*	resident	common [units unknown]	A3	Least Concern
Large-billed Leaf-warbler *Phylloscopus magnirostris*	breeding	uncommon [units unknown]	A3	Least Concern
Grey-hooded Warbler *Phylloscopus xanthoschistos*	resident	common [units unknown]	A3	Least Concern
Grey-cheeked Warbler *Seicercus poliogenys*	resident	rare [units unknown]	A3	Least Concern
Black-faced Warbler *Abroscopus schisticeps*	resident	frequent [units unknown]	A3	Least Concern
Rusty-cheeked Scimitar-babbler *Pomatorhinus erythrogenys*	resident	common [units unknown]	A3	Least Concern
Slender-billed Scimitar-babbler *Xiphirhynchus superciliaris*	resident	rare [units unknown]	A3	Least Concern
Scaly-breasted Wren-babbler *Pnoepyga albiventer*	resident	frequent [units unknown]	A3	Least Concern
Nepal Wren-babbler *Pnoepyga immaculata*	resident	rare [units unknown]	A2	Least Concern
Rufous-capped Babbler *Stachyris ruficeps*	unknown	unknown [units unknown]	A3	Least Concern
Black-chinned Babbler *Stachyris pyrrhops*	resident	frequent [units unknown]	A3	Least Concern
Spiny Babbler *Turdoides nipalensis*	resident	frequent [units unknown]	A2	Least Concern
White-throated Laughingthrush *Garrulax albogularis*	resident	common [units unknown]	A3	Least Concern
Striated Laughingthrush *Garrulax striatus*	resident	common [units unknown]	A3	Least Concern
Rufous-chinned Laughingthrush *Garrulax rufogularis*	resident	uncommon [units unknown]	A3	Least Concern
Spotted Laughingthrush *Garrulax ocellatus*	resident	frequent [units unknown]	A3	Least Concern
Grey-sided Laughingthrush *Garrulax caerulatus*	resident	rare [units unknown]	A3	Least Concern
Streaked Laughingthrush *Garrulax lineatus*	resident	common [units unknown]	A3	Least Concern
Blue-winged Laughingthrush *Garrulax squamatus*	resident	rare [units unknown]	A3	Least Concern
Scaly Laughingthrush *Garrulax subunicolor*	resident	uncommon [units unknown]	A3	Least Concern
Variegated Laughingthrush *Garrulax variegatus*	resident	common [units unknown]	A3	Least Concern
Black-faced Laughingthrush *Garrulax affinis*	resident	common [units unknown]	A3	Least Concern
Red-billed Leiothrix *Leiothrix lutea*	resident	frequent [units unknown]	A3	Least Concern
Himalayan Cutia *Cutia nipalensis*	resident	rare [units unknown]	A3	Least Concern
Black-headed Shrike-babbler *Pteruthius rufiventer*	resident	rare [units unknown]	A3	Least Concern

Species	Season	Population estimate	IBA Criteria	IUCN Category
Green Shrike-babbler *Pteruthius xanthochlorus*	resident	uncommon [units unknown]	A3	Least Concern
Rusty-fronted Barwing *Actinodura egertoni*	unknown	unknown [units unknown]	A3	Least Concern
Hoary-throated Barwing *Actinodura nipalensis*	resident	frequent [units unknown]	A2	Least Concern
Blue-winged Minla *Minla cyanouroptera*	resident	frequent [units unknown]	A3	Least Concern
Chestnut-tailed Minla *Minla strigula*	resident	common [units unknown]	A3	Least Concern
Red-tailed Minla *Minla ignotincta*	resident	uncommon [units unknown]	A3	Least Concern
Golden-breasted Fulvetta *Alcippe chrysotis*	resident	frequent [units unknown]	A3	Least Concern
Yellow-throated Fulvetta *Alcippe cinerea*	unknown	unknown [units unknown]	A3	Least Concern
White-browed Fulvetta *Alcippe vinipectus*	resident	common [units unknown]	A3	Least Concern
Nepal Fulvetta *Alcippe nipalensis*	resident	uncommon [units unknown]	A3	Least Concern
Rufous-backed Sibia *Heterophasia annectens*	unknown	unknown [units unknown]	A3	Least Concern
Rufous Sibia *Heterophasia capistrata*	resident	common [units unknown]	A3	Least Concern
Stripe-throated Yuhina *Yuhina gularis*	resident	common [units unknown]	A3	Least Concern
Rufous-vented Yuhina *Yuhina occipitalis*	resident	common [units unknown]	A3	Least Concern
Great Parrotbill *Conostoma oemodium*	resident	uncommon [units unknown]	A3	Least Concern
Brown Parrotbill *Paradoxornis unicolor*	resident	uncommon [units unknown]	A3	Least Concern
Fulvous Parrotbill *Paradoxornis fulvifrons*	resident	uncommon [units unknown]	A3	Least Concern
Fire-tailed Myzornis *Myzornis pyrrhoura*	resident	rare [units unknown]	A3	Least Concern
White-tailed Nuthatch *Sitta himalayensis*	resident	common [units unknown]	A3	Least Concern
Bar-tailed Treecreeper *Certhia himalayana*	resident	frequent [units unknown]	A3	Least Concern
Rusty-flanked Treecreeper *Certhia nipalensis*	resident	frequent [units unknown]	A3	Least Concern
Long-billed Thrush *Zoothera monticola*	resident	uncommon [units unknown]	A3	Least Concern
Tickell's Thrush *Turdus unicolor*	breeding	uncommon [units unknown]	A3	Least Concern
White-collared Blackbird *Turdus albocinctus*	resident	frequent [units unknown]	A3	Least Concern
Grey-winged Blackbird *Turdus boulboul*	resident	frequent [units unknown]	A3	Least Concern
White-tailed Rubythroat *Luscinia pectoralis*	breeding	uncommon [units unknown]	A3	Least Concern
Indian Blue Robin *Luscinia brunnea*	breeding	frequent [units unknown]	A3	Least Concern
Golden Bush-robin *Tarsiger chrysaeus*	resident	uncommon [units unknown]	A3	Least Concern
White-browed Bush-robin *Tarsiger indicus*	resident	uncommon [units unknown]	A3	Least Concern
Rufous-breasted Bush-robin *Tarsiger hyperythrus*	resident	uncommon [units unknown]	A3	Least Concern

Species	Season	Population estimate	IBA Criteria	IUCN Category
Blue-capped Redstart *Phoenicurus caeruleocephala*	resident	frequent [units unknown]	A3	Least Concern
White-throated Redstart *Phoenicurus schisticeps*	resident	uncommon [units unknown]	A3	Least Concern
White-bellied Redstart *Hodgsonius phaenicuroides*	breeding	uncommon [units unknown]	A3	Least Concern
White-tailed Robin *Cinclidium leucurum*	resident	uncommon [units unknown]	A3	Least Concern
Grandala *Grandala coelicolor*	unknown	frequent [units unknown]	A3	Least Concern
Slaty-backed Forktail *Enicurus schistaceus*	resident	frequent [units unknown]	A3	Least Concern
Blue-capped Rock-thrush *Monticola cinclorhynchus*	breeding	uncommon [units unknown]	A3	Least Concern
Rusty-tailed Flycatcher *Muscicapa ruficauda*	breeding	uncommon [units unknown]	A3	Least Concern
Ferruginous Flycatcher *Muscicapa ferruginea*	breeding	rare [units unknown]	A3	Least Concern
Rufous-gorgeted Flycatcher *Ficedula strophiata*	resident	common [units unknown]	A3	Least Concern
White-gorgeted Flycatcher *Ficedula monileger*	resident	rare [units unknown]	A3	Least Concern
Ultramarine Flycatcher *Ficedula superciliaris*	breeding	common [units unknown]	A3	Least Concern
Slaty-blue Flycatcher *Ficedula tricolor*	resident	common [units unknown]	A3	Least Concern
Small Niltava *Niltava macgrigoriae*	breeding	frequent [units unknown]	A3	Least Concern
Rufous-bellied Niltava *Niltava sundara*	resident	common [units unknown]	A3	Least Concern
Orange-bellied Leafbird *Chloropsis hardwickii*	resident	uncommon [units unknown]	A3	Least Concern
Yellow-bellied Flowerpecker *Dicaeum melanoxanthum*	resident	uncommon [units unknown]	A3	Least Concern
Black-throated Sunbird *Aethopyga saturata*	resident	uncommon [units unknown]	A3	Least Concern
Fire-tailed Sunbird *Aethopyga ignicauda*	resident	frequent [units unknown]	A3	Least Concern
Black-winged Snowfinch *Montifringilla adamsi*	resident	present [units unknown]	A3	Least Concern
White-rumped Snowfinch *Montifringilla taczanowskii*	unknown	present [units unknown]	A3	Least Concern
Plain-backed Snowfinch *Montifringilla blanfordi*	unknown	present [units unknown]	A3	Least Concern
Rufous-breasted Accentor *Prunella strophiata*	resident	frequent [units unknown]	A3	Least Concern
Brown Accentor *Prunella fulvescens*	unknown	frequent [units unknown]	A3	Least Concern
Rosy Pipit *Anthus roseatus*	breeding	frequent [units unknown]	A3	Least Concern
Yellow-breasted Greenfinch *Carduelis spinoides*	resident	common [units unknown]	A3	Least Concern
Plain Mountain-finch *Leucosticte nemoricola*	resident	common [units unknown]	A3	Least Concern
Spectacled Finch *Callacanthis burtoni*	unknown	uncommon [units unknown]	A2	Least Concern
Dark-breasted Rosefinch *Carpodacus nipalensis*	resident	frequent [units unknown]	A3	Least Concern
Beautiful Rosefinch *Carpodacus pulcherrimus*	resident	common [units unknown]	A3	Least Concern

Species	Season	Population estimate	IBA Criteria	IUCN Category
Pink-browed Rosefinch *Carpodacus rodochroa*	resident	frequent [units unknown]	A3	Least Concern
Vinaceous Rosefinch *Carpodacus vinaceus*	unknown	rare [units unknown]	A3	Least Concern
Dark-rumped Rosefinch *Carpodacus edwardsii*	unknown	unknown [units unknown]	A3	Least Concern
Spot-winged Rosefinch *Carpodacus rodopeplus*	resident	frequent [units unknown]	A3	Least Concern
White-browed Rosefinch *Carpodacus thura*	resident	frequent [units unknown]	A3	Least Concern
Great Rosefinch *Carpodacus rubicilla*	resident	uncommon [units unknown]	A3	Least Concern
Red-fronted Rosefinch *Carpodacus puniceus*	unknown	uncommon [units unknown]	A3	Least Concern
Crimson-browed Finch *Pinicola subhimachala*	unknown	uncommon [units unknown]	A3	Least Concern
Scarlet Finch *Haematospiza sipahi*	resident	uncommon [units unknown]	A3	Least Concern
Brown Bullfinch *Pyrrhula nipalensis*	resident	uncommon [units unknown]	A3	Least Concern
Red-headed Bullfinch *Pyrrhula erythrocephala*	resident	frequent [units unknown]	A3	Least Concern
Collared Grosbeak *Mycerobas affinis*	resident	frequent [units unknown]	A3	Least Concern
Spot-winged Grosbeak *Mycerobas melanozanthos*	resident	rare [units unknown]	A3	Least Concern
White-winged Grosbeak *Mycerobas carnipes*	resident	frequent [units unknown]	A3	Least Concern
Gold-naped Finch *Pyrrhoplectes epauletta*	resident	rare [units unknown]	A3	Least Concern

Source: BirdLife International (2013) Important Bird Areas factsheet: Annapurna Conservation Area. Downloaded from http://www.birdlife.org on 08/08/2013

Table 2: List of Bird Species found in Farmlands in Lumbini area
Farmlands in Lumbini area
Central coordinates 83° 17.00' East 27° 29.00' North
Area 141,367 ha

Species	Season	Population estimate	IBA Criteria	IUCN Category
Indian Peafowl *Pavo cristatus*	unknown	present [units unknown]	A3	Least Concern
Painted Stork *Mycteria leucocephala*	non-breeding	rare [units unknown]	A1	Near Threatened
Lesser Adjutant *Leptoptilos javanicus*	unknown	frequent [units unknown]	A1, A4i	Vulnerable
Black-headed Ibis *Threskiornis melanocephalus*	non-breeding	rare [units unknown]	A1	Near Threatened
Red-naped Ibis *Pseudibis papillosa*	unknown	present [units unknown]	A3	Least Concern
Pallas's Fish-eagle *Haliaeetus leucoryphus*	passage	unknown [units unknown]	A1	Vulnerable
White-rumped Vulture *Gyps bengalensis*	resident	uncommon [units unknown]	A1, A3	Critically Endangered
Slender-billed Vulture *Gyps tenuirostris*	resident	uncommon [units unknown]	A1, A3	Critically Endangered
Red-headed Vulture *Sarcogyps calvus*	unknown	present [units unknown]	A3	Critically Endangered

Species	Season	Population estimate	IBA Criteria	IUCN Category
Cinereous Vulture *Aegypius monachus*	passage	rare [units unknown]	A1	Near Threatened
White-eyed Buzzard *Butastur teesa*	unknown	present [units unknown]	A3	Least Concern
Indian Spotted Eagle *Aquila hastata*	resident	rare [units unknown]	A1	Vulnerable
Sarus Crane *Grus antigone*	resident	common [units unknown]	A1, A4i	Vulnerable
Yellow-footed Green-pigeon *Treron phoenicopterus*	unknown	present [units unknown]	A3	Least Concern
Plum-headed Parakeet *Psittacula cyanocephala*	unknown	present [units unknown]	A3	Least Concern
Indian Grey Hornbill *Ocyceros birostris*	unknown	present [units unknown]	A3	Least Concern
Lineated Barbet *Megalaima lineata*	unknown	present [units unknown]	A3	Least Concern
Yellow-crowned Woodpecker *Dendrocopos mahrattensis*	unknown	present [units unknown]	A3	Least Concern
Black-rumped Flameback *Dinopium benghalense*	unknown	present [units unknown]	A3	Least Concern
Common Woodshrike *Tephrodornis pondicerianus*	unknown	present [units unknown]	A3	Least Concern
Small Minivet *Pericrocotus cinnamomeus*	unknown	present [units unknown]	A3	Least Concern
White-bellied Drongo *Dicrurus caerulescens*	unknown	present [units unknown]	A3	Least Concern
White-browed Fantail *Rhipidura aureola*	unknown	present [units unknown]	A3	Least Concern
Rufous-winged Lark *Mirafra assamica*	unknown	present [units unknown]	A3	Least Concern
Indian Short-toed Lark *Calandrella raytal*	unknown	present [units unknown]	A3	Least Concern
Ashy-crowned Sparrow-lark *Eremopterix griseus*	unknown	present [units unknown]	A3	Least Concern
Bristled Grassbird *Chaetornis striata*	breeding	rare [units unknown]	A1	Vulnerable
Large Grey Babbler *Turdoides malcolmi*	unknown	present [units unknown]	A3	Least Concern
Jungle Babbler *Turdoides striata*	unknown	present [units unknown]	A3	Least Concern
Bank Myna *Acridotheres ginginianus*	unknown	present [units unknown]	A3	Least Concern
Chestnut-tailed Starling *Sturnus malabaricus*	unknown	present [units unknown]	A3	Least Concern
Brahminy Starling *Sturnus pagodarum*	unknown	present [units unknown]	A3	Least Concern
Indian Robin *Saxicoloides fulicatus*	unknown	present [units unknown]	A3	Least Concern
White-throated Bushchat *Saxicola insignis*	passage	rare [units unknown]	A1	Vulnerable
Yellow-breasted Bunting *Emberiza aureola*	winter	unknown [units unknown]	A1	Vulnerable

Source: BirdLife International (2013) Important Bird Areas factsheet: Farmlands in Lumbini Area. Downloaded from http://www.birdlife.org on 08/08/2013

Table 3: List of Bird Species found in Shivapuri-Nagarjun National Park
Shivapuri-Nagarjun National Park
Central coordinates 85° 20.00' East 27° 48.00' North
Area 15,900 ha

Species	Season	Population estimate	IBA Criteria	IUCN Category
Hill Partridge *Arborophila torqueola*	resident	uncommon [units unknown]	A3	Least Concern
Speckled Wood-pigeon *Columba hodgsonii*	unknown	present [units unknown]	A3	Least Concern
Golden-throated Barbet *Megalaima franklinii*	resident	uncommon [units unknown]	A3	Least Concern
Darjeeling Woodpecker *Dendrocopos darjellensis*	resident	uncommon [units unknown]	A3	Least Concern
Maroon Oriole *Oriolus traillii*	resident	uncommon [units unknown]	A3	Least Concern
Grey Treepie *Dendrocitta formosae*	resident	common [units unknown]	A3	Least Concern
Green-backed *Tit Parus monticolus*	resident	common [units unknown]	A3	Least Concern
Yellow-browed Tit *Sylviparus modestus*	resident	common [units unknown]	A3	Least Concern
Black-throated Tit *Aegithalos concinnus*	resident	common [units unknown]	A3	Least Concern
Himalayan Bulbul *Pycnonotus leucogenys*	resident	common [units unknown]	A3	Least Concern
Mountain Bulbul *Hypsipetes mcclellandii*	resident	common [units unknown]	A3	Least Concern
Asian Black Bulbul *Hypsipetes leucocephalus*	resident	common [units unknown]	A3	Least Concern
Hume's Bush-warbler *Cettia brunnescens*	resident	uncommon [units unknown]	A3	Least Concern
Buff-barred Warbler *Phylloscopus pulcher*	resident	common [units unknown]	A3	Least Concern
Grey-hooded Warbler *Phylloscopus xanthoschistos*	resident	common [units unknown]	A3	Least Concern
Black-faced Warbler *Abroscopus schisticeps*	resident	frequent [units unknown]	A3	Least Concern
Rusty-cheeked Scimitar-babbler *Pomatorhinus erythrogenys*	resident	common [units unknown]	A3	Least Concern
Black-chinned Babbler *Stachyris pyrrhops*	resident	common [units unknown]	A3	Least Concern
Spiny Babbler *Turdoides nipalensis*	resident	frequent [units unknown]	A2	Least Concern
White-throated Laughingthrush *Garrulax albogularis*	resident	common [units unknown]	A3	Least Concern
Striated Laughingthrush *Garrulax striatus*	resident	common [units unknown]	A3	Least Concern
Rufous-chinned Laughingthrush *Garrulax rufogularis*	resident	uncommon [units unknown]	A3	Least Concern
Grey-sided Laughingthrush *Garrulax caerulatus*	resident	rare [units unknown]	A3	Least Concern
Streaked Laughingthrush *Garrulax lineatus*	resident	uncommon [units unknown]	A3	Least Concern
Red-billed Leiothrix *Leiothrix lutea*	resident	uncommon [units unknown]	A3	Least Concern
Green Shrike-babbler *Pteruthius xanthochlorus*	resident	uncommon [units unknown]	A3	Least Concern
Hoary-throated Barwing *Actinodura nipalensis*	resident	frequent [units unknown]	A2	Least Concern
Chestnut-tailed Minla *Minla strigula*	resident	common [units unknown]	A3	Least Concern
Red-tailed Minla *Minla ignotincta*	resident	frequent [units	A3	Least Concern

Species	Season	Population estimate	IBA Criteria	IUCN Category
		unknown]		
White-browed Fulvetta *Alcippe vinipectus*	resident	common [units unknown]	A3	Least Concern
Nepal Fulvetta *Alcippe nipalensis*	resident	frequent [units unknown]	A3	Least Concern
Rufous Sibia *Heterophasia capistrata*	resident	common [units unknown]	A3	Least Concern
Stripe-throated Yuhina *Yuhina gularis*	resident	common [units unknown]	A3	Least Concern
White-tailed Nuthatch *Sitta himalayensis*	resident	common [units unknown]	A3	Least Concern
Tickell's Thrush *Turdus unicolor*	breeding	uncommon [units unknown]	A3	Least Concern
Grey-winged Blackbird *Turdus boulboul*	resident	uncommon [units unknown]	A3	Least Concern
Blue-capped Rock-thrush *Monticola cinclorhynchus*	breeding	uncommon [units unknown]	A3	Least Concern
Ultramarine Flycatcher *Ficedula superciliaris*	breeding	uncommon [units unknown]	A3	Least Concern
Small Niltava *Niltava macgrigoriae*	resident	uncommon [units unknown]	A3	Least Concern
Rufous-bellied Niltava *Niltava sundara*	resident	uncommon [units unknown]	A3	Least Concern
Brown Bullfinch *Pyrrhula nipalensis*	resident	uncommon [units unknown]	A3	Least Concern

Source: BirdLife International (2013) Important Bird Areas factsheet: Shivapuri-Nagarjun National Park. Downloaded from http://www.birdlife.org on 08/12/2013

Table 4: List of Bird Species found in Bharandabhar Forest and Wetlands

Bharandabhar Forest and Wetlands
Central Coordinates 84° 10.00' East 27° 40.00' North
Area 12,300 ha
Protected Area Contained by the Site: Beeshazar and Associated Lakes (Ramsar Site)

Species	Season	Population estimate	IBA Criteria	IUCN Category
Indian Peafowl *Pavo cristatus*	unknown	present [units unknown]	A3	Least Concern
Ferruginous Duck *Aythya nyroca*	winter	rare [units unknown]	A1	Near Threatened
Painted Stork *Mycteria leucocephala*	breeding	rare [units unknown]	A1	Near Threatened
Black-necked Stork *Ephippiorhynchus asiaticus*	non-breeding	rare [units unknown]	A1	Near Threatened
Lesser Adjutant *Leptoptilos javanicus*	resident	frequent [units unknown]	A1, A4i	Vulnerable
Red-naped Ibis *Pseudibis papillosa*	unknown	present [units unknown]	A3	Least Concern
Oriental Darter *Anhinga melanogaster*	resident	present [units unknown]	A1, A4i	Near Threatened
Pallas's Fish-eagle *Haliaeetus leucoryphus*	winter	rare [units unknown]	A1	Vulnerable
Lesser Fish-eagle *Ichthyophaga humilis*	non-breeding	rare [units unknown]	A1	Near Threatened
Grey-headed Fish-eagle *Ichthyophaga ichthyaetus*	resident	frequent [units unknown]	A1	Near Threatened
White-rumped Vulture *Gyps bengalensis*	resident	unknown [units unknown]	A1, A3	Critically Endangered
Slender-billed Vulture *Gyps tenuirostris*	resident	unknown [units	A1, A3	Critically

Species	Season	Population estimate	IBA Criteria	IUCN Category
		unknown]		Endangered
Red-headed Vulture *Sarcogyps calvus*	non-breeding	unknown [units unknown]	A1	Critically Endangered
Cinereous Vulture *Aegypius monachus*	winter	rare [units unknown]	A1	Near Threatened
White-eyed Buzzard *Butastur teesa*	unknown	present [units unknown]	A3	Least Concern
Indian Spotted Eagle *Aquila hastata*	unknown	unknown [units unknown]	A1	Vulnerable
Greater Spotted Eagle *Aquila clanga*	winter	rare [units unknown]	A1	Vulnerable
Lesser Florican *Sypheotides indicus*	unknown	present [units unknown]	A3	Endangered
Black-bellied Tern *Sterna acuticauda*	non-breeding	rare [units unknown]	A1	Endangered
Yellow-footed Green-pigeon *Treron phoenicopterus*	unknown	present [units unknown]	A3	Least Concern
Plum-headed Parakeet *Psittacula cyanocephala*	unknown	present [units unknown]	A3	Least Concern
Sirkeer Malkoha *Phaenicophaeus leschenaultii*	unknown	present [units unknown]	A3	Least Concern
Indian Grey Hornbill *Ocyceros birostris*	unknown	present [units unknown]	A3	Least Concern
Great Hornbill *Buceros bicornis*	resident	rare [units unknown]	A1	Near Threatened
Brown-headed Barbet *Megalaima zeylanica*	unknown	present [units unknown]	A3	Least Concern
Lineated Barbet *Megalaima lineata*	unknown	present [units unknown]	A3	Least Concern
Yellow-crowned Woodpecker *Dendrocopos mahrattensis*	unknown	present [units unknown]	A3	Least Concern
Black-rumped Flameback *Dinopium benghalense*	unknown	present [units unknown]	A3	Least Concern
Ashy Woodswallow *Artamus fuscus*	unknown	present [units unknown]	A3	Least Concern
Common Woodshrike *Tephrodornis pondicerianus*	unknown	present [units unknown]	A3	Least Concern
Black-headed Cuckooshrike *Coracina melanoptera*	unknown	present [units unknown]	A3	Least Concern
Small Minivet *Pericrocotus cinnamomeus*	unknown	present [units unknown]	A3	Least Concern
White-bellied Drongo *Dicrurus caerulescens*	unknown	present [units unknown]	A3	Least Concern
White-browed Fantail *Rhipidura aureola*	unknown	present [units unknown]	A3	Least Concern
Rufous-winged Lark *Mirafra assamica*	unknown	present [units unknown]	A3	Least Concern
Indian Short-toed Lark *Calandrella raytal*	unknown	present [units unknown]	A3	Least Concern
Ashy-crowned Sparrow-lark *Eremopterix griseus*	unknown	present [units unknown]	A3	Least Concern
Jungle Prinia *Prinia sylvatica*	unknown	present [units unknown]	A3	Least Concern
Ashy Prinia *Prinia socialis*	unknown	present [units unknown]	A3	Least Concern
Tawny-bellied Babbler *Dumetia*	unknown	present [units	A3	Least

Species	Season	Population estimate	IBA Criteria	IUCN Category
hyperythra		unknown]		Concern
Jungle Babbler *Turdoides striata*	unknown	present [units unknown]	A3	Least Concern
Bank Myna *Acridotheres ginginianus*	unknown	present [units unknown]	A3	Least Concern
Chestnut-tailed Starling *Sturnus malabaricus*	unknown	present [units unknown]	A3	Least Concern
Brahminy Starling *Sturnus pagodarum*	unknown	present [units unknown]	A3	Least Concern

Source: BirdLife International (2013) Important Bird Areas factsheet: Bharandabhar Forest and Wetlands. Downloaded from http://www.birdlife.org on 08/08/2013

Table 5: List of Important Protected Species in Annapurna Conservation Area

Common names	Scientific names	NPWC Act	NRDB(1995)	IUCN	CITES
Mammals					
Red panda	*Ailurus fulgens*	P	E	VU	I
Snow leopard	*Uncia uncia*	P	E	EN	I
Jungle cat	*Felis chaus*		S	LC	II
Leopard cat	*Prionailurus bengalensis*	P	V	LC	II
Golden cat	*Catopuma temminckii*		V	NT	I
Clouded leopard	*Pardofelis nebulosa*	P	V	VU	I
Marbled cat	*Pardofelis marmorata*		V	VU	I
Himalayan lynx	*Lynx lynx isabellinus*	P	E	LC	II
Forest leopard	*Panthera pardus*		S	NT	I
Dhole	*Cuon alpinus*		V	EN	II
Grey wolf	*Canis lupus*	P	V	LC	I
Red fox	*Vulpes vulpes*		S	LC	III
Tibetan sand fox	*Vulpes ferrilata*		S	LC	
Asiatic black bear	*Ursus thibetanus*		V	VU	I
Himalayan brown bear	*Ursus arctos*	P	V	LC	I
Indian flying fox	*Pteropus giganteus*			LC	II
Common otter	*Lutra lutra*		S	NT	I
Smooth-coated otter	*Lutrogale perspicillata*		S	VU	II
Spotted lingsang	*Prionodon pardicolor*	P		LC	I
Tibetan argali	*Ovis ammon hodgsoni*	P	C	NT	I
Tibetan gazelle	*Procapra picticaudata*			NT	
Tibetan wild ass	*Equus kiang kiang*			LC	II
Himalayan musk deer	*Moschus chrysogaster*	P	E	EN	I
Himalayan goral	*Naemorhedus goral*		S	NT	I
Mainland serow	*Narmorhedus sumatraensis*		S	NT	I
Chinese pangolin	*Manis pentadactyla*	P	S	EN	II
Assamese monkey	*Macaca assamensis*	P		NT	II
Rhesus monkey	*Macaca mulatta*		S	LC	II
Herpatofauna					
Indian bull frog	*Hoplobatrachus tigerinus*			LC	II
Mustang frog	*Paa rostandi*		S	VU	
Annapurna ground skink	*Asymblepharus capitaneus*		S		
Golden monitor	*Varanus flavescens*	P	S	LC	I
Burmese rock python	*Python bivittatus*	P	V	VU	I
Rat snake	*Ptyas mocosus mocosus*		S		II
King cobra	*Ophiophagus hannah*		V	VU	I

Source: (NTNC, 2008), (IUCN, 2013), Wikipedia, Birdlife International and CITES Appendix from 5th August 2013.
Legend: C= critical, E= endangered, S= susceptible, V= Vulnerable, P= protected, LC (IUCN)= least concern, EN= endangered, VU= vulnerable, CITES (I, II, III)= Appendices

Table 6: List of Important Protected Species in Annapurna Conservation Area

Nepali Name	Scientific Name	CITES Appendix	IUCN Red List	Forest Regulation 1995
Kutki	*Neopicrorhiza scrophularifollora*		listed	Protected
Talispatra	*Abies spectabilis*	-	NT	Protected
Panchaunle	*Dactylorhiza hatagirea*	-	-	Protected
Yarsagumba	*Cordyceps sinensis*	-	-	Protected
Unyu	*Cythia spinulosa*	II	-	-
Jatamansi	*Nardostachys grandiflora*		listed	Protected

Source: *(NTNC, 2008), (IUCN, 2013)*

Table 7: Protected Plant Species and Forest Products (Pursuant to Section 70 (kha) of the Forest Act 1993)

S.N	Scientific Name	Local Name	Family	IUCN Status	CITES Appendices
1	*Dactylorhiza hatagirea*	Panch Ounle	Orchidaceae		II
2	*Juglans regia* (only bark)	Okhar	Juglandaceae	NT	
3	*Picrorhiza scrophulariflora**	Kutki	Scrophulariaceae		
	Plants banned for export except processed in the country and permission issued from DOF along with the recommendation of DPR or HPPCL				
4	*Abies spectabilis*	Talis patra	Piniaceae		
5	*Cinnamomum glaucescens*	Sugandakokila	Lauraceae		
6	Lichens spp.	Jhyau			
7	*Nardostachys grandiflora*	Jatamansi	Valerianaceae		
8	*Rauvolfia serpentine*	Sarpganda	Apocynaceae	V	
		Harbaruwa		E	II
9	*Taxus baccata* subsp. *Wallichiana*	Loth salla	Valerianaceae		
10	*Valerianna jatamansi*	Sugandabala	Valerianaceae		II
	Forest product banned for export except processed in the country through boiling and extraction method permission issued from DOF along with the recommendation of DPR or HPPCL				
11	Asphaltum (rock exudate)	Silajit			
	Ban on export except processed in the country through steaming and packaging, and permission issued from DOF along with the recommendation of DPR or HPPCL				
12	*Cordyceps sinensis*	Yarsa gomba	Clavicipitaceae		
	Timber trees banned for felling, transportation and export for commercial purposes				
13	*Acacia catechu*	Khayer	Leguminosae		
14	*Bombax ceiba*	Simal	Bombacaceae		
15	*Dalbergia latifolia*	Satissal	Fabaceae		
16	*Juglans regia* (only of national forest)	Okhar	Juglandaceae		
17	*Michelia champaka*	Champ	Magnoliaceae		
	Michelia kisopa				
18	*Pterocarpus marsupium*	Bijaya Sal	Fabaceae		
19	*Shorea robusta*	Sal	Dipterocarpaceae		

Source: HMG, 2001. Nepal Gazette. Section 51 and No. 36, and Section 53 & No. 31), HMG press, Kathmandu (31 December 2001 (2058/9/16), and 17 November 2003 (2060/8/1). Cited by (Uprety, 2003)

Notes: This prohibition will not apply to trees to be felled as per the Operational Forest Management Plant, and of areas implementation of the national priority projects. DOF= Department of Forests; DPR= Department of Plant Resource, and HPPCL= Herbs Production and Processing Company Limited.

* Species to be specified and recommended fpr export by DPR, and availability to be considered by DOF before issuing license for export.

Table 8: Protected Wildlife under NPWC Act 1973 including their status

Scientific Name	Local Name	Common Name	IUCN Status	CITES Appendices
Mammals				
Ailurus fulgens	Habrey	Red Panda	V	III
Antilope cervicapra	Krishnasar	Black buck	NT	III
Bos gaurus	Gor budson	Gaur bison	V	I
Bos mutus	Yok nak	Wild Yak	E	I
Bubalus arnee	Arna	Wild water buffalo	E	III
Canis lupus	Bwanso	Grey wolf	V	I
Caprolagus hispidus	Hispid Kharayo	Hispid Hare	EN	I
Cervus duvauceli	Barasinghe	Swamp deer	VU	I
Elephas maximus	Hatti	Asiatic Elephant	EN	I
Felis lynx		Lynx	E	II
Hyaena hyaena	Hundar	Striped hyaena	NT	
Macaca assamensis	Asamese rato bander	Asamese monkey		
Manis crassicaudata	Salak	Indian pangolin		II
Manis pentadactyla	Salak	Chinese pangolin		II
Moschus chrysogaster	Kasturi mirga	Himalayan forest musk deer	EN	I
Ovis ammon	Nayan	Great Tibetan Sheep		I
Panthera tigris	Bagh	Bengal tiger	EN	I
Panthera uncial	Hiun chitwa	Snow Leopard	EN	I
Pantholops hodgsoni	Chiru	Tibetan Antelope		I
Pardofelis nebulosa	Dwanse chitwa	Clouded Leopard	VU	I
Platanista gangetica	Suns	Gangetic dolphin	EN	I
Prionailurus bengalensis	Chari bagh	Leopard cat		I
Prionodon pardicolor	Silu	Spotted Lisang		I
Rhinoceros unicornis	Gainda	Asian one-horned rhinoceros	VU	II
Sus salvanius	Sano (Pudke) bandel	Pigmy hog	CR	I
Tetracerus quadricornis	Chauka	Fore-horned antelope	VU	III
Ursus arctos	Himali rato bhalu	Brown bear		I
Birds				
Buceros bicornis	Thulo dhanesh	Great-horned hornbill	NT	I
Catreus wallishii	Cheer	Cheer pheasant	EN	I
Ciconia ciconia	Seto sarus	White stork		
Ciconia nigra	Kalo sarus	Black stork		II
Eupodotis bengalensis	Khar mujur	Bengal florican	EN	I
Grus grus (G. antigone)	Sarus	Common crane		I
Lophophorous impejanus	Danfe	Impeyan pheasant		I
Sypheotides indica	Sano Khar Mujur	Lessor florican	EN	II
Tragopan satyra	Monal	Crimson horned pheasant		III
Reptiles				
Gavialis gangeticus	Ghadial gohi	Gharial	EN	I
Python molurus	Azingar	Asiatic rock python	VU	
Varanus flavescens	Sun gohori	Golden monitor lizard		I

Source: MFCS/GEF/UNDP. 2002
CR=Critically Endangered, EN=Endangered, VU=Vulnerable, C=Common, NT=Near Threatened

Table 9: Nepal's Flora Listed in the CITES Appendices

	Scientific Name	English Name	Local Name	Family
Appendix I				
1	*Saussrea lappa*		Kuth	Compositae
Appendix II				
2	*Ceropedia pubescens*	Milkweeds		Asclepiadaceae
3	*Cyatheaceae*	Tree ferns	Rukh Unyu	Cyatheaceae
4	*Cycadaceae*	Cycas	Jokar	
5	*Dioscorea deltoidea*	Disocorea	Ban tarul, Bhyakur	Dioscoreaceae
6	*Orchicaceae*	Orchids	Sungava	
7	*Podophyllim hexandrum*	May apple		Berberidaceae
8	*Rauvolfia serpentina**	Rauwolfia root	Sarpagandha	Apocynaceae
9	*Taxus wallichiana**	Himalayan yew	Lauth salla	Taxaceae
Appendix III				
10	*Cycas pectinata*	Cycas	Jokar	Cycadaceae
11	*Gnetum montanum*	Gnetum		Gnetaceae
12	*Meconopsis regia*	Himalayan yellow poppy		Papaveraceae
13	*Podocarpus neriifolius*	Podocarpus		Podocarpaceae
14	*Talauma hodgsonii*	Magnolia		Magnoliaceae
15	*Tetracentron sinense*	Tetracentron		Tetreacentraceae

* Legally protected in Nepal by publishing in Nepal Gazette under the Forests Act, 1993 and its Rules, 1995
Source: (MFSC/GEF/UNDP, 2002)

Table 10: Nepal's Fauna Listed in CITES Appendices

Mammals (Total 58)					
Appendix I (Total 29)		**Appendix II (Total 7)**		**Appendix III (Total 22)**	
1	*Ailurus fulgens* (Red Panda)	1	*Cuon alpinus* (Wild dog)	1	*Antilope cervicapra* (Black buck)
2	*Bos gaurus* (Gaur bison)	2	*Equus hemionus* (Wild ass)	2	*Arctictis binturong* (Bear cat)
3	*Bos grunnies* (Yak)	3	*Manis* species (Pangolin)	3	*Bubalus arne* (Wild buffalo)
4	*Canis lupus* (Wolf)	4	*Primates* species (Monkey)	4	*Canis aureus* (Jackal)
5	*Capra falconeri* (Markhor)	5	*Pteropus* species (Flying fox)	5	*Herpestes edwardsii* (Common mongoose)
6	*Caprolagus hispidus* (Hispid hare)	6	*Ratufa* species (Squirrel)	6	*Herpestes fuscus* (Brown mongoose)
7	*Cervus duvauceli* (Swamp deer)	7	*Tupaia glis* (Common tree shrew)	7	*Herpestes urva* (Crab-eating mongoose)
8	*Elephas maximus* (Elephant)			8	*Marmota himlayana* (Himalayan marmot)
9	*Delis bengalensis* (Leopard cat)			9	*Martes flavigula* (Yellow-throated marten)
10	*Felis marmorata* (Marble cat)			10	*Martes foina intermedia* (Stone marten)
11	*Felis temmincki* (Golden cat)			11	*Mellivora capensis* (Haoney badger)
12	*Lutra lutra* (Otter)			12	*Mustela altaica* (Pale weasel)
13	*Melursus ursinus* (Sloth bear)			13	*Mustela kathiah* (Yellow-bellied Weasel)
14	*Moschus chrysigaster* (Musk deer)			14	*Mustela sibirica* (Himalayan weasel)
15	*Naemorhedus goral* (Ghoral)			15	*Paguma larvata* (Himalayan palm)
16	*Naemorhedus sumatraensis* (Himalayan serow)			16	*Paradosurus hermaphrod* (Common palm civet)
17	*Neofelis nebulosa* (Clouded leopard)			17	*Paradoxurus jerdoni* (Brown palm civet)
18	*Ovis ammon hodgsonii* (Argali)			18	*Tetracerus quadricornis* (Four-horned antelope)
19	*Panthera tigris* (tiger)			19	*Viverra zibetha* (Large Indian civet)
20	*Panthera pardus* (Common Leopard)			20	*Viverricula indca* (Small Indian civet)
21	*Uncia uncia* (Snow			21	*Vulpes bengalensis* (Indian

	leopard)				fox)
22	*Pantholops hodgsoni* (Chiru)			22	*Vulpes montana* (Mountain fox)
23	*Platanista gangetica* (Gangetic Dolphin)				
24	*Presbytis entellus* (Langur)				
25	*Prionodon pardicolor* (Linsang)				
26	*Rhinoceros unicornis* (Greater One-horned Rhinoceros)				
27	*Selenarctos thibetanus* (Himalayan black bear)				
28	*Sus salvanius* (Pygmy hog)				
29	*Ursus arctos* (Brown bear)				
Birds (Total 40)					
Appendix I (Total 16)		**Appendix II (Total 9)**		**Appendix III (Total 15)**	
1	*Aceros nepalensis* (Rufous-necked hornbill)	1	*Anthracoceros* species (Pied hornbill)	1	*Anas acuta* (Northern pintail)
2	*Aquila heliaca* (Imperial eagle)	2	*Ciconia nigra* (Black stork)	2	*Anas cypeata* (Northern shoveler)
3	*Ardeotis nigricepas* (Great Indian bustard)	3	*Falconiformes* species (Falcon)	3	*Anas crecca* (Common tern)
4	*Buceros bicornis* (Giant hornbill)	4	*Gruidae* species (Crane)	4	*Anas penelope* (Eurasian wigeon)
5	*Catreus wallichii* (Cheer pheasant)	5	*Ithaginis cruentus* (Blood pheasant)	5	*Anas querquedula* Garganey)
6	*Eupodotis bengalensis* (Bengal florican)	6	*Otididae*species (Lesser florican)	6	*Aythya nyroca* (White-eyed pochard)
7	*Falco jugger* (Lagger falcon)	7	*Pitta nympha* (Indian pitta)	7	*Bubulcus ibis* (Cattel egret)
8	*Falco pelegrinoides* (Barbary falcon)	8	*Platelea leucorodia* (Eurasian spoonbill)	8	*Casmerodius albus* (Great egret)
9	*Falco peregrinus* (Red-capped falcon)	9	*Sarkidiornis melanotos* (Comb duck {Nakta})	9	*Columba livia* (Rock pigeon)
10	*Grus nigricollis* (Black-necked crane)			10	*Dendrocygna bicolor* (Fulvous whistling duck)
11	*Haliaeetus albicilla* (White-tailed eagle)			11	*Egretta gsrtzetta* (Little egret)
12	*Lophophorous impejanus* (Himalayan monal)			12	*Gracula religiosa* (Talking mynah)
13	*Psittacula karmeri* (Rose ringed parakeet)			13	*Streptopelia senegalensis* (Laughing dove)
14	*Rhodonessa caryophyllaceae* (Pink-headed duck)			14	*Threskiornis aethiopicus* (Black-headed ibis)
15	*Tetraogallus tibeatanus* (Tibetan snowcock)			15	*Tragopan satyra* (Crimson-horned pheasant)
16	*Tragopan melanocephalus* (Western horned pheasant)				
Reptiles (Total 13)					
	Appendix I (Total 7)	**Appendix II (Total 4)**		**Appendix III (Total 2)**	
1	*Crocodulus palustris* (Mugger crocodile)	1	*Elachistodon westermanni* (Indian egg-eating snake)	1	*Viperra russelli* (Russle's viper)
2	*Gravialis gangeticus* (Gharial)	2	*Naja naja* (Cobra)	2	*Xenochrophis piscator* (Checkerd keelback)
3	*Python molurus molurus* (Indian python)	3	*Ophiophagus hannah* (King cobra)		
4	*Testudinidae* species (Land tortoise)	4	*Ptyas mucosus* (Dhaman or common rat snake)		
5	*Trionyx gangeticus* (Ganges softshell)				
6	*Trionyx hurum* (Peacock softshell)				
7	*Varanus flavescens* (Golden				

	monitor lizard)				
Amphibians (Total 1)					
		Appendix II			
		1	*Rana tigerina*(Indian bull frog)		
Insects (Total 2)					
			Appendix II		
		1	*Troides aeacus aeacus* (Golden birdwing)		
		2	*Troides helena* subsp. *Serberus* (Common birdwing)		

Source: (Uprety, 2003)

Table 11: Non-endemic Threatened Plants included in the IUCN Category

SN	Scientific Name	Family	IUCN Category
1	*Allium przewalskianum*	Amaryllidaceae	V
2	*Choerospondias axillaries*	Anacardiaceae	R
3	*Pistacia chinensis subsp. Integerrina*	Anacardiaceae	R
4	*Alstonia neriifolia*	Apocynaceae	R
5	*Alstonia scholaris*	Apocynaceae	R
6	*Beaumontia grandiflora*	Apocynaceae	V
7	*Rauvolfia serpentine*	Apocynaceae	E
8	*Arisaema untile*	Araceae	I
9	*Helwingia himalaica*	Araliaceae	I
10	*Hoya amottiana*	Asclepiadaceae	K
11	*Tylophora belsotemma*	Asclepiadaceae	Ex?
12	*Podophyllum hexandrum*	Berberidaceae	V
13	*Alnus nitida*	Betulaceae	R
14	*Oroxylum indicum*	Bignoniaceae	V
15	*Maharanga bicolour*	Boraginaceae	K
16	*Maharanga emodi*	Boraginaceae	K
17	*Crateva unllocularis*	Capparaceae	R
18	*Megacarpaea polyandra*	Cruciferae	V
19	*Cycas pectinata*	Cycadaceae	E
20	*Dioscorea deltoidea*	Dioscoreaceae	T
21	*Dioscorea prazeri*	Dioscoreaceae	T
22	*Elaeocarpus sphaericus*	Elaeocarpaceae	V
23	*Lithocarpus fenestrate*	Fagaceae	K
24	*Swertia chirayita*	Gnetaceae	E
25	*Gnetum montanum*	Gnetaceae	E
26	*Acacia catechu*	Fabaceae	T
27	*Butea monsperma*	Fabaceae	E
28	*Dalbergia latifolia*	Fabaceae	V
29	*Gloriosa superb*	Liliaceae	R
30	*Lillium wallichianum*	Liliaceae	R
31	*Paris polyphylla*	Liliaceae	V
32	*Magnolia globosa*	Magnoliaceae	R
33	*Michelia champaca*	Magnoliaceae	E
34	*Michelia kisopa*	Magnoliaceae	E
35	*Talauma hodgsonii*	Magnoliaceae	E
36	*Olea ferruginea*	Ileaceae	R
37	*Paeonia emodi*	Paeoniaceae	R
38	*Calamus acanthospathus*	Palmae	E
39	*Calamus latifolius*	Palmae	E

40	*Calamus leptospadix*	Palmae	E
41	*Wallichia densiflora*	Palmae	R
42	*Passiflora napalensis*	Passifloraceae	E
43	*Larix griffithiana*	Piniaceae	R
44	*Larix himalaica*	Piniaceae	K
45	*Ceratostigma ulicinum*	Plumbaginaceae	R
46	*Podocarpus neriifolius*	Podocarpaceae	E
47	*Hydrobryum griffithii*	Podostemaceae	R
48	*Rheum nobile*	Polugonaceae	R
49	*Helicia nilagirica*	Proteaceae	R
50	*Aconitum ferox*	Ranunculaceae	T
51	*Aconitum gammiei*	Ranunculaceae	R
52	*Aconitum heterophyllum*	Ranunculaceae	R
53	*Aconitum laciniatum*	Ranunculaceae	T
54	*Aconitum spicatum*	Ranunculaceae	T
55	*Prunus carmesina*	Rosaceae	R
56	*Bergenia ciliate*	Saxifragaceae	T
57	*Picrorhiza scrophulariaefolia*	Scrophulariaceae	R
58	*Tetracentron sinense*	Tetracentraceae	R
59	*Ulmus wallichiana*	Ulmaceae	R
60	*Nardostachys grandiflora*	Valerianaceae	V

Source: (MFSC/GEF/UNDP, 2002)

Table 12: Nepal's Threatened Animals in the IUCN List, 1994

Order/Family		Scientific Name	Common Name	Status
Class: Mammalia	1	*Canis lupus*	Grey Wolf	V
	2	*Cuon alpines*	Asiatic Wild	V
	3	*Vulpes benghalensis*	Bengal Fox	I
Felidae	4	*Catopuma temmincki (Felis temmincki)*	Asiatic Golden Cat	I
	5	*Neofelis nebulosa*	Clouded Leopard	I
	6	*Panthera tigris tigris*	Tiger	E
	7	*Prionaliurus marmorata, (Felis marmorata)*	Marbled Cat	K
	8	*Prionaliurus viverrinus, Felis viverrinus, Felis viverrina)*	Fishing Cat	
	9	*Uncia uncia (Panthera uncia)*	Snow Leopard	E
Mustelidae	10	*Aonyx cinerea*	Oriental Small-clawed Otter	K
	11	*Autra perspicillata*	Smooth-coated Otter	K
Ursidae	12	*Ailurus fulgens*	Lesser Panda (Red Panda)	V
	13	*Melurus ursinus (Ursus ursinus)*	Sloth Bear	V
	14	*Selenarctos thibetanus (Ursus thibetanus)*	Asiatic Black Bear	V
Cetacea/Latanestidae	15	*Platanista gangetica*	Ganges River Dolphin	V
Proboscidea/Elephantidae	16	*Elephas maximus*	Asian Elephant	E
Perissodactayla/Rhinocerotidae	17	*Rhinoceros unicornis*	Greater One-horned-Rhinoceros	E
Artiodactyla/Suidae	18	*Sus salvanius*	Pygmy Hog	E
Cervidae	19	*Cervus duvauceli duvauceli*	Swamp Deer	I
Bovidae	20	*Antelope cervicapra*	Blackbuck	V
	21	*Bos gaurus (B.frontalis)*	Gaur	V
	22	*Bos mutus (B.grunnies)*	Wild Yak	E
	23	*Bubalus arnee (B.bubalus)*	Wild Water Buffalo	E
	24	*Capricornis sumatraensis (Naemorhedus sumatraensis)*	Mainland Serrow	T
	25	*Hemitragus jemlahicus*	Himalayan Thar	K

	26	*Tetracerus quadricornis*	Four-horned Antelope	V
Lagomorpha/ Ochotonidae	27	*Ochotona nubrica*	Nubra Pika	I
Leporidae	28	*Caprolagus hispidus*	Hispid Hare	E
Class: Aves				
Pelacaniformes/Pelacanidae	1	*Pelecanus phillippensis*	Spot-billed Pelican	I
Ciciniformes/	2	*Leptoptilos dubius*	Greater Adjutant Stork	V
	3	*Leptoptilos javanicus*		
	4	*Aythya baeri*	Baee's Pochard	V
	5	*Aegypius monachus*	Cinerous Vulture	V
	6	*Aquila heliacal*	Imperial Eagle	R
	7	*Haliaeetus albicvilla*	White-tailed Eagle	V
	8	*Haliaeetus leucocryphus*	Pallas's Sea Eagle	R
	9	*Falco naumanni*	Lesser Florican	E
	10	*Catreus wallichi*	Cheer Pheasant	E
	11	*Francolinus gularis*	WSwamp Francolin	V
	12	*Tragopan melanocephalus*	Western Tragopan	E
	13	*Eupodotis bengalensis (Houbaropsis bengalensis)*	Bengal florican	E
		Eudotis indica (Sypheotides indica)	Lesser Florican	E
	15	*Gallinago nemoricola*	Wood Snipe	I
	16	*Alcedo Hercules*	Blyth's Kingfisher	E
	17	*Aceros nipalensis*	Rofous-necked Hornbill	R
	18	*Chaetornis striatus*	Bristled Grassbird	K
	19	*Chysomma altirostris (Moupinia altirostris)*	Jerdon's Babbler	V
	20	*Paradoxornis flavirostris*	Black-breasted Parrotbill	I
	21	*Saxicola insignis*	White-throated Bushchat	K
	22	*Spelaeornis caudatus*	Rufous-throated Wren-babbler	K
Class: Reptillia				
Testudines/	1	*Geoclemys hamiltonii (Domania hamiltonii)*	Black Pond Turtle	I
	2	*Kachuga kachuga*	Red-crowned Roofed Turtle	I
	3	*Melanochelys tricarinato (Geochelone or Nicoria tricarinata)*	Three-keeled Land Tortoise	I
	4	*Indotestudo elongata (Geochelone elongata)*	Elongated Tortoise	K
Crocodyla/ Crocodylidae	5	*Crocodylus palustris*	Mugger	V
Gavialidae	6	*Gavialis gangeticus*	Gharial	E
Sauria/Varanidae	7	*Varanus flavescens*	Yellow Monitor Lizard	I
Serpentes/Boidae	8	*Python molurus*	Indian Python	V
Colubridae	9	*Elachistodon westermanni*	Indian Egg-eating Snake	R
Class: Insecta Odanata/ Epipophlebiidae	1	*Epipophlebia laidlawi*	Relict Himalayan Dragonfly	V
Lepidoptera/ Papilionidae	2	*Teinopalpus imperialis*	Kaiser-I-Hind	R

Source: (MFSC/GEF/UNDP, 2002)

IUCN Definitions

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

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

Rare (R) = Taxa with small world populations 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.

Figure 1: Suitability for growing Barley

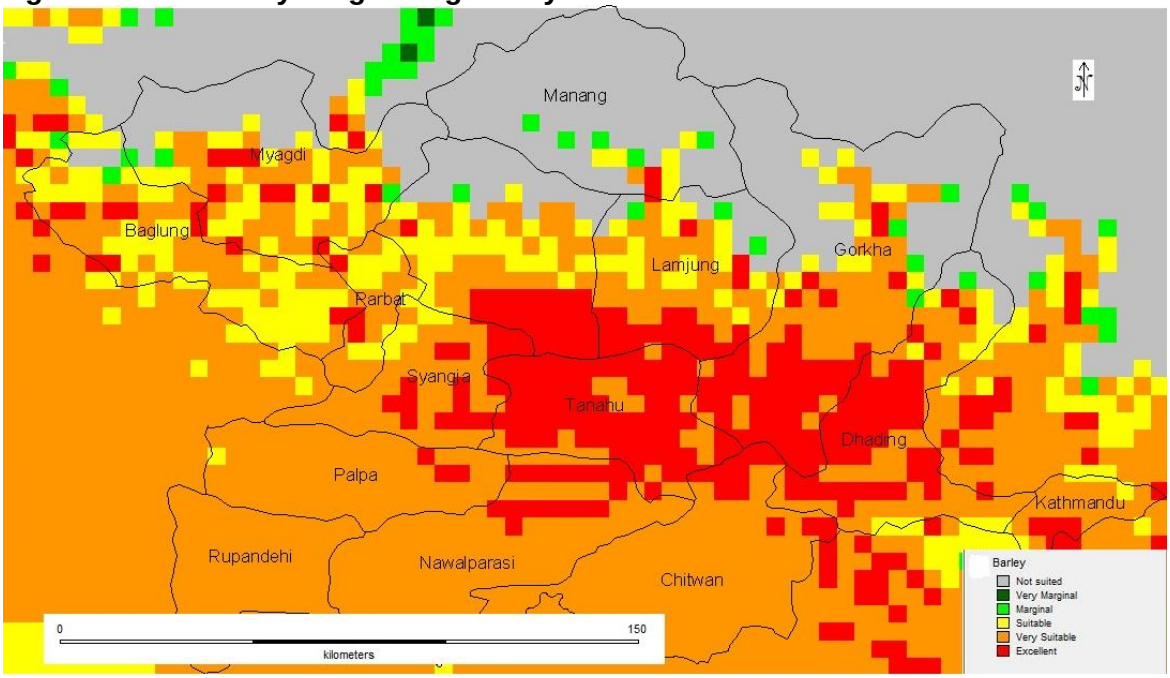


Figure 2: Suitability for growing Buckwheat

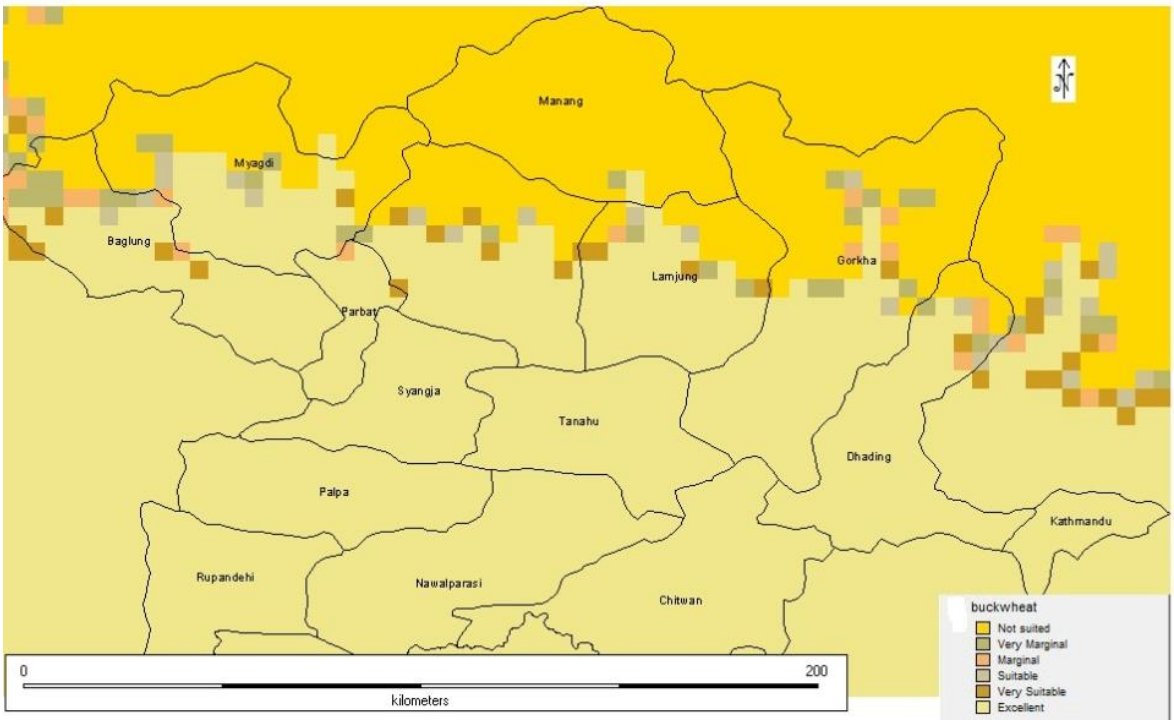


Figure 3: Suitability for growing Maize

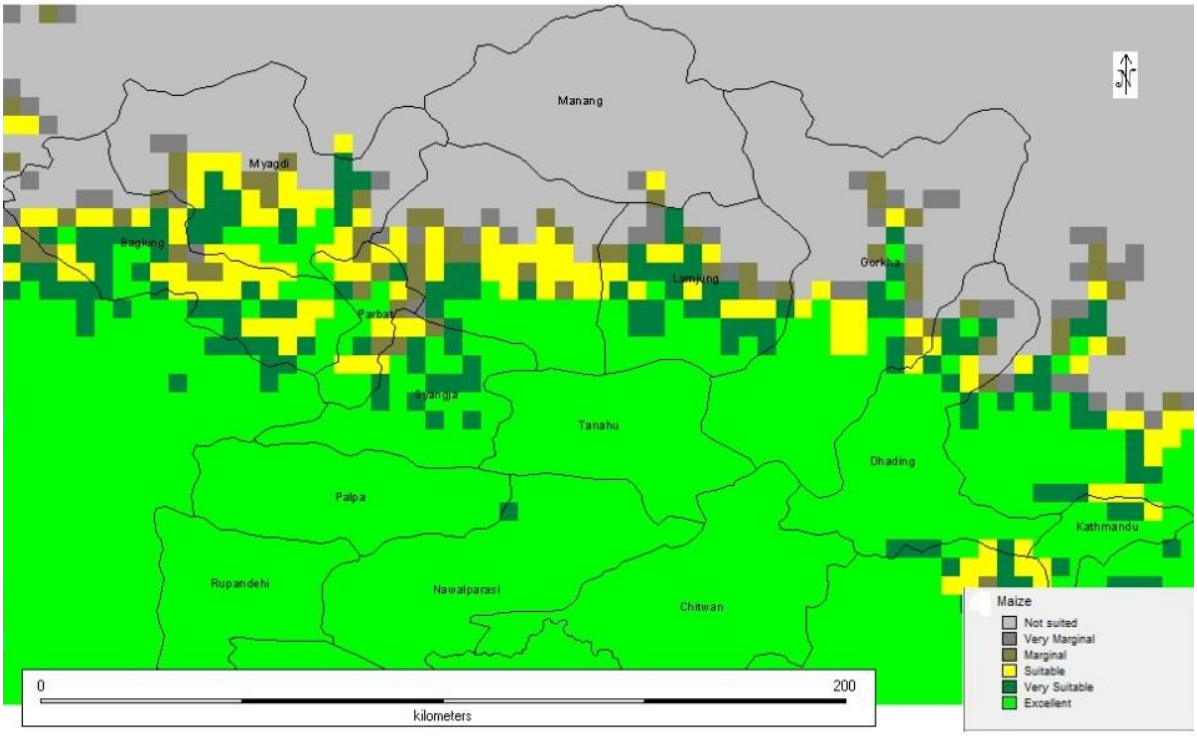


Figure 4: Suitability for growing Millet

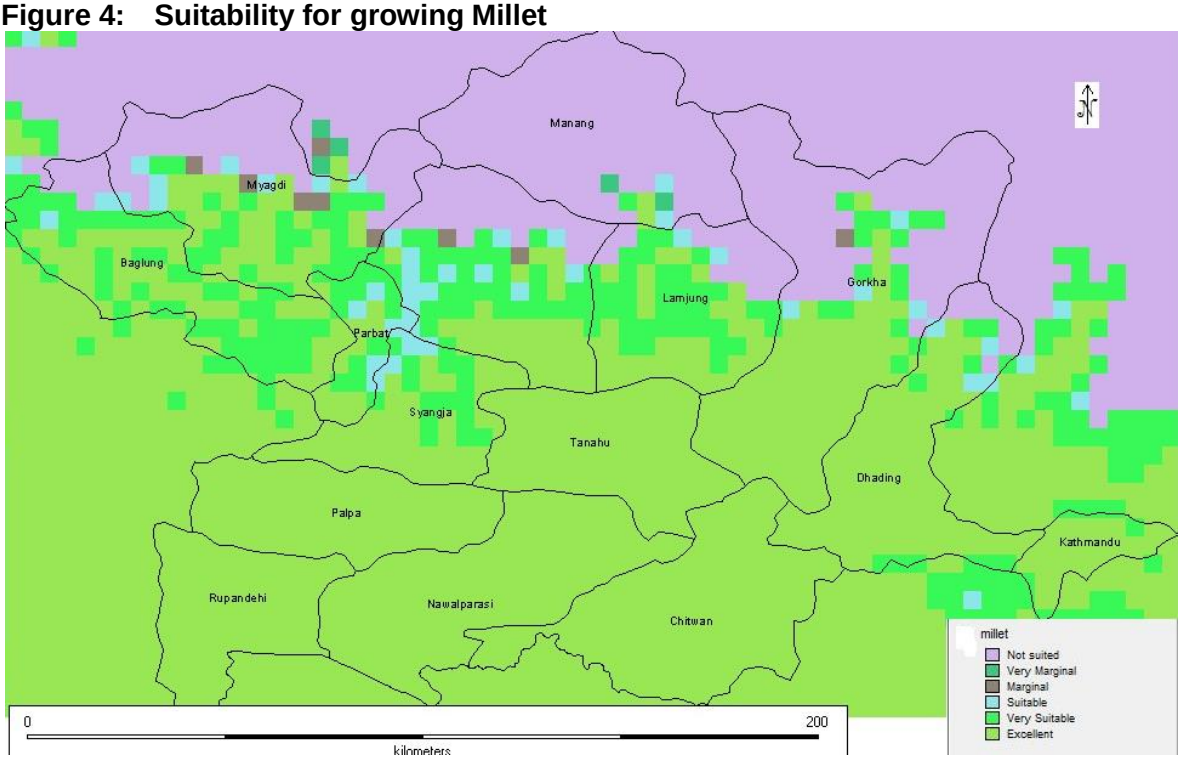


Figure 5: Suitability for growing Potatoe

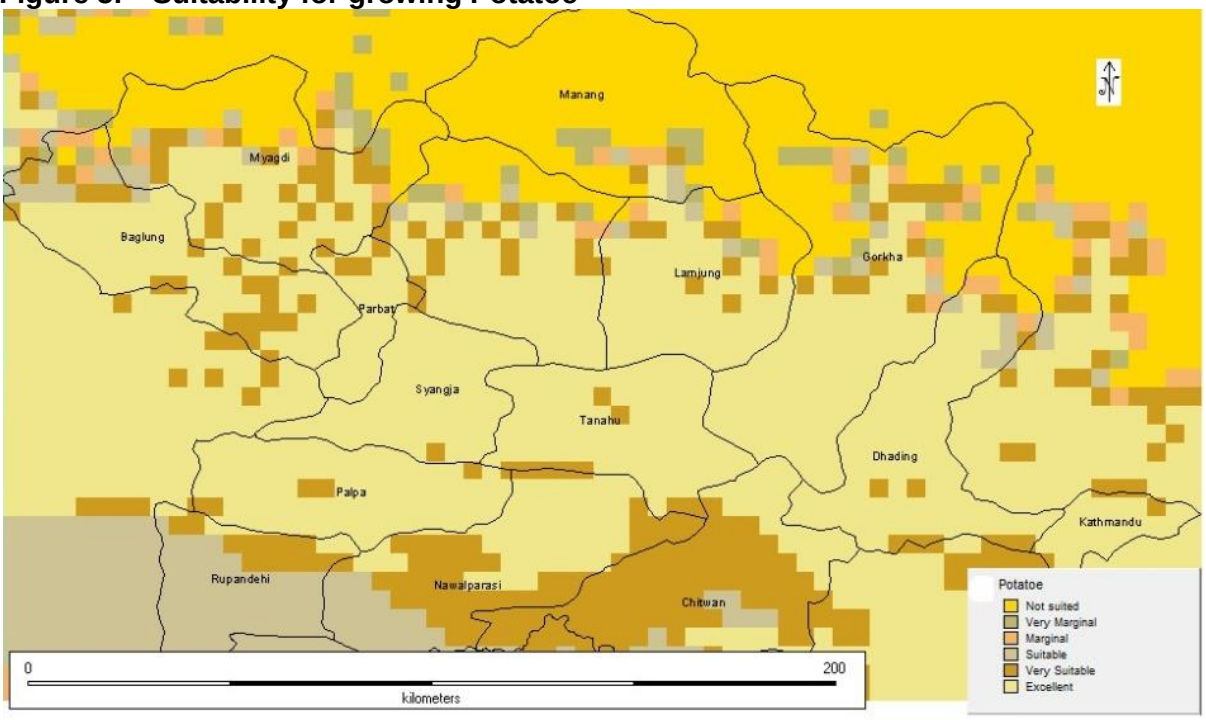


Figure 6: Suitability for growing Paddy

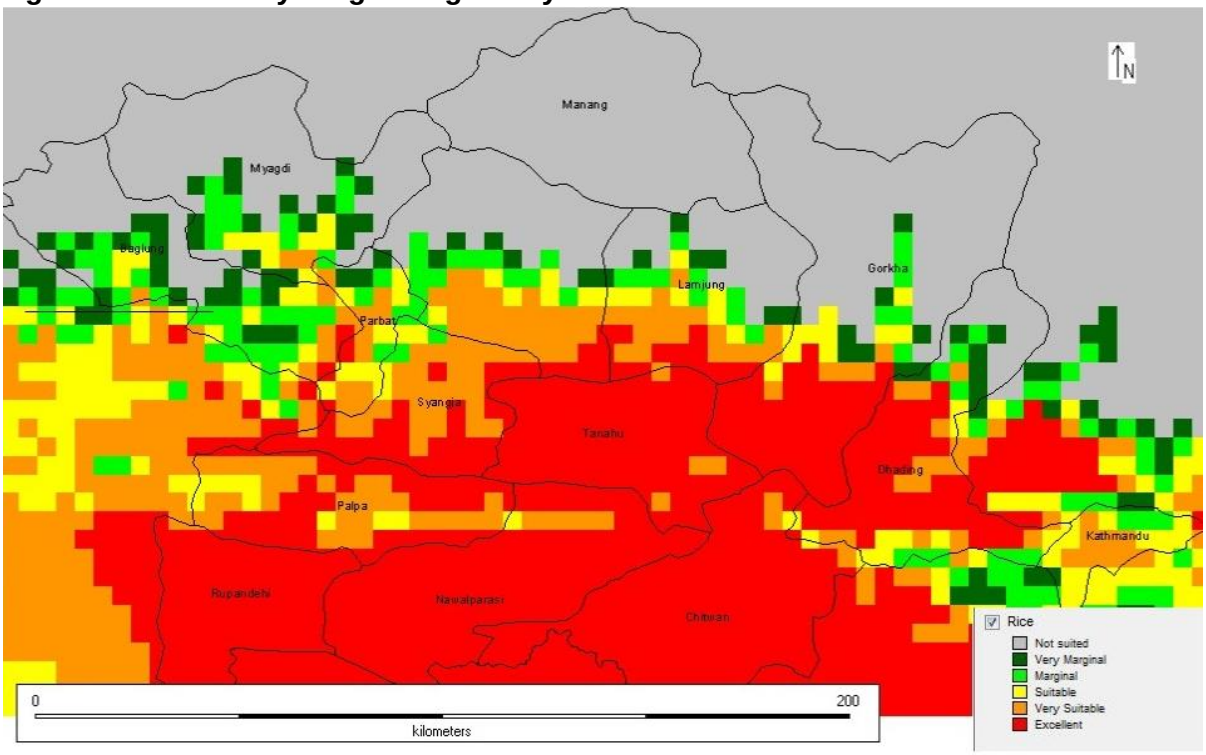
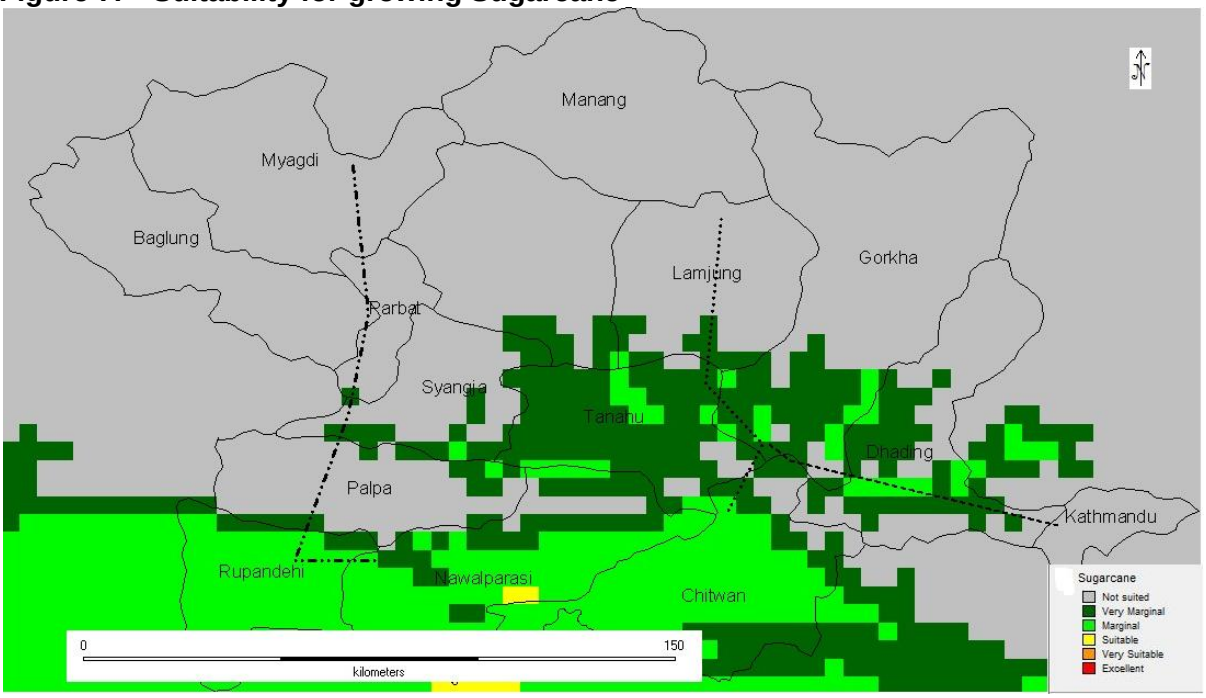


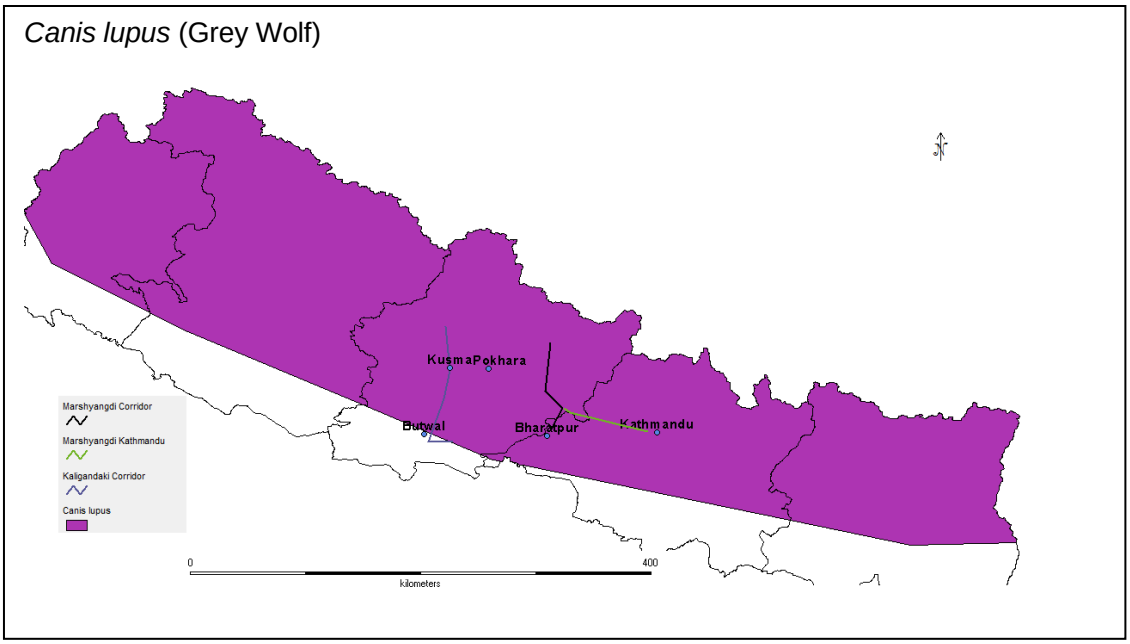
Figure 7: Suitability for growing Sugarcane



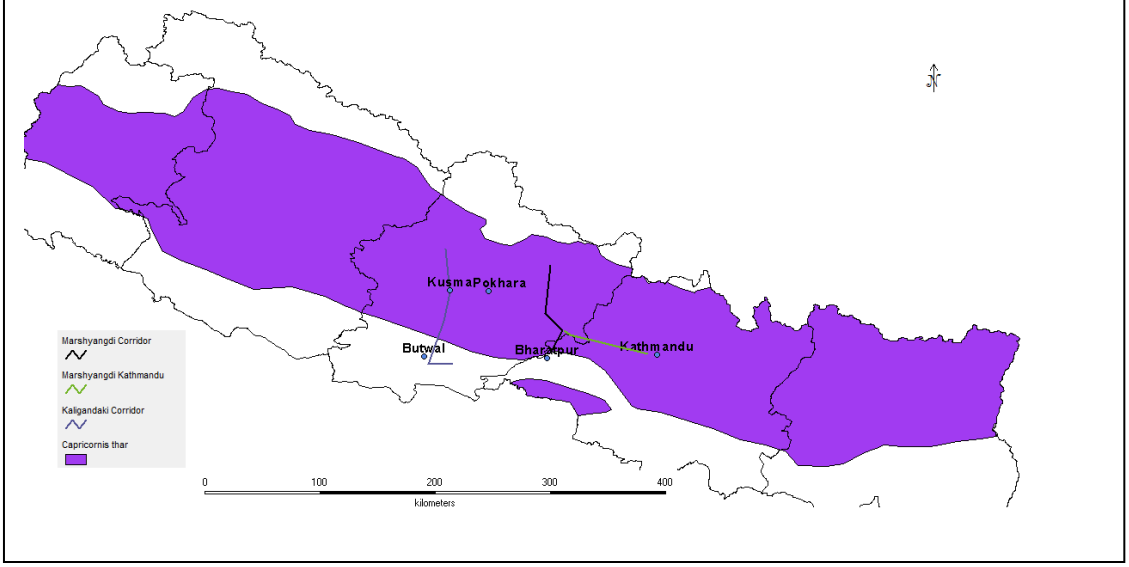
Source: FAO

Appendix 2: Potential Habitat Distribution of Important Species
Mammals

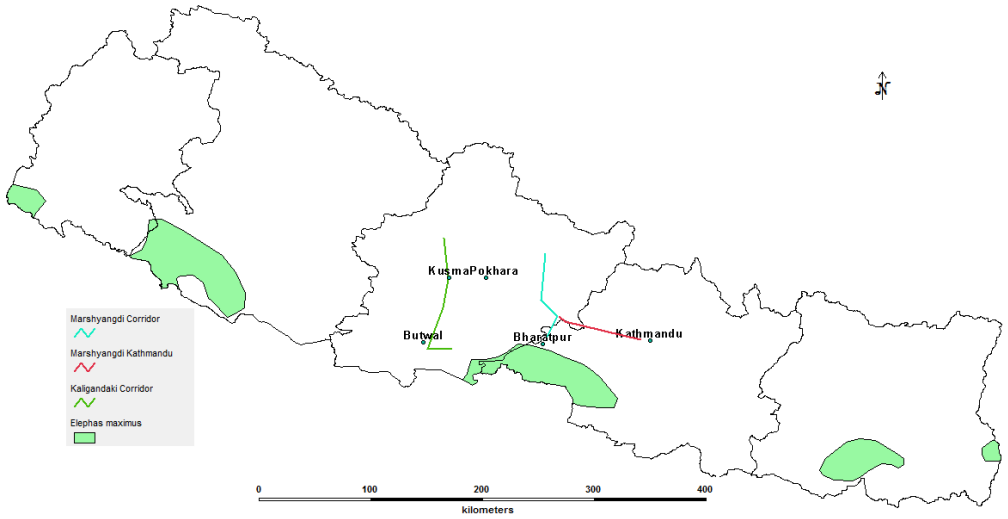
Canis lupus (Grey Wolf)



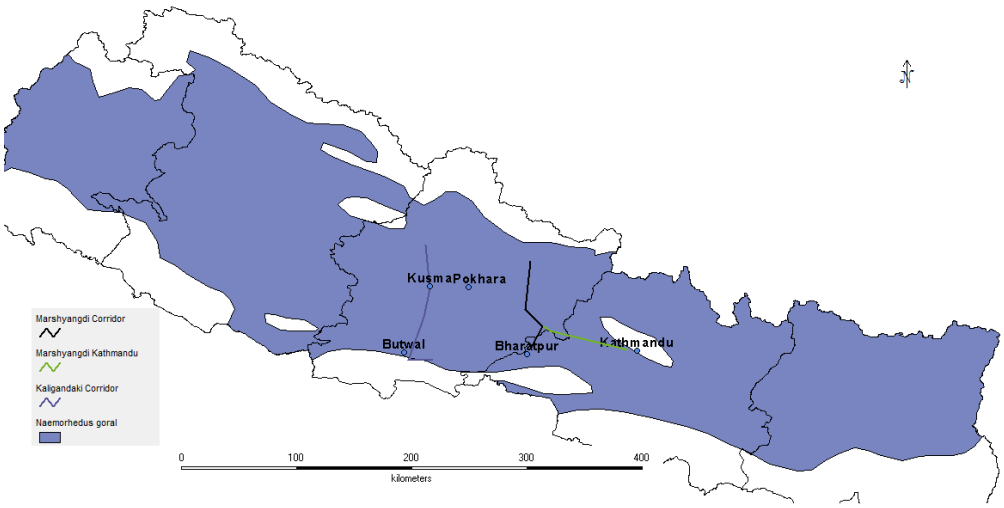
Capricornis thar



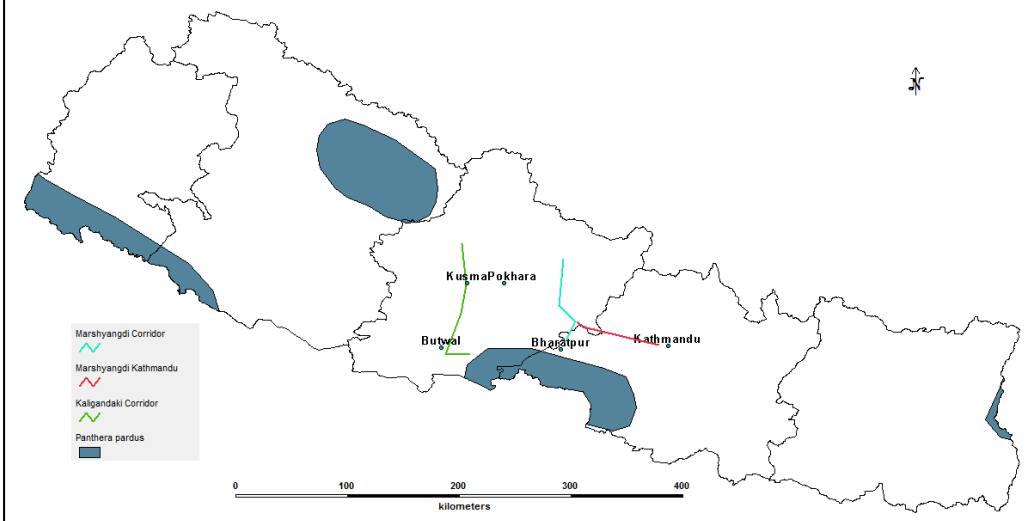
Elephas maximus (Asian Elephant)



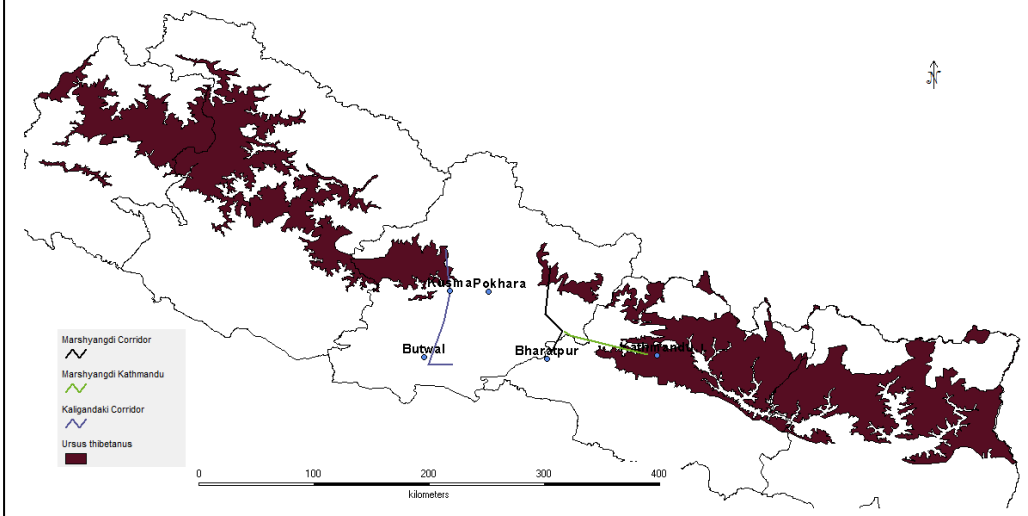
Naemorhedus goral (Himalayan goral)



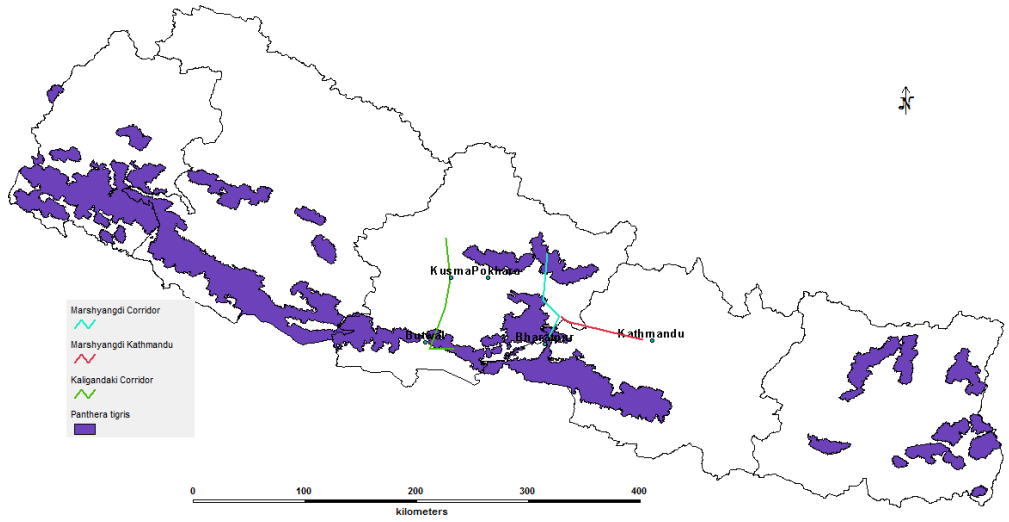
Panthera pardus (Common Leopard)



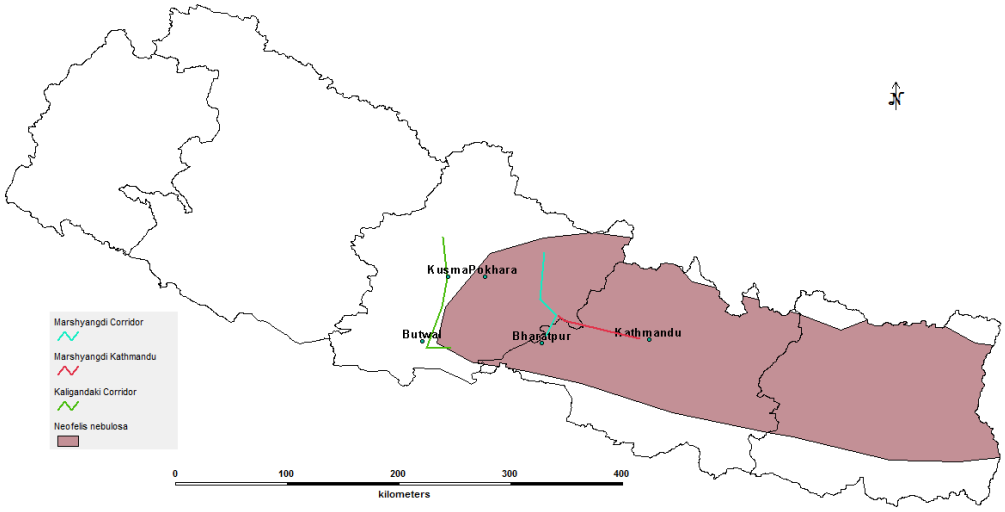
Ursus thibetanus (Asiatic Black Bear)



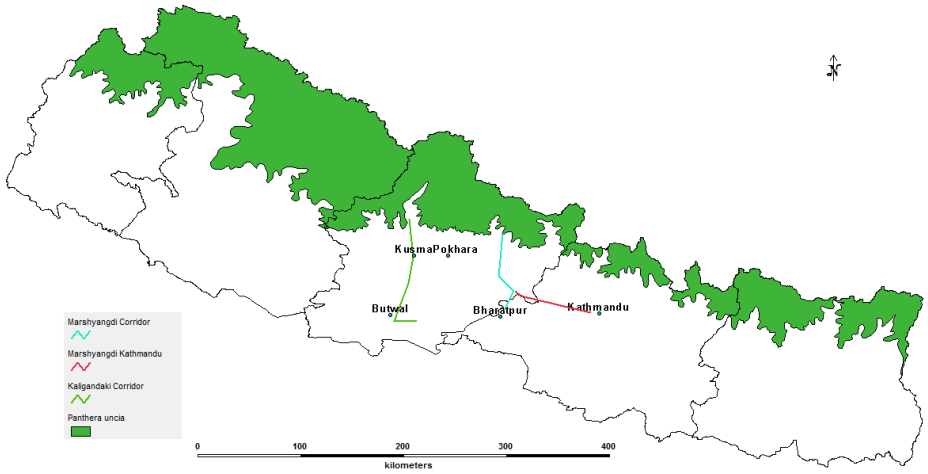
Panthera tigris (Bengal tiger)



Neofelis nebulosa (Clouded leopard)

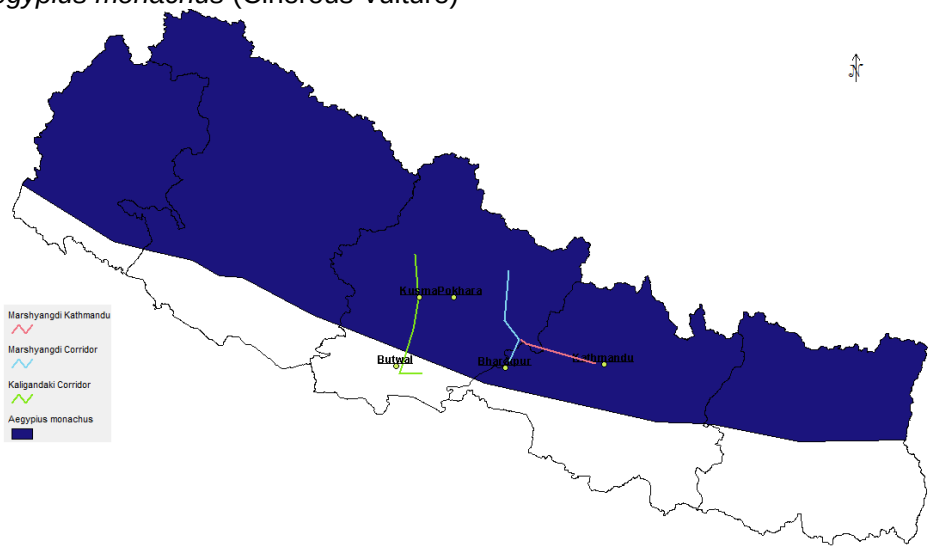


Panthera uncia (Snow Leopard)

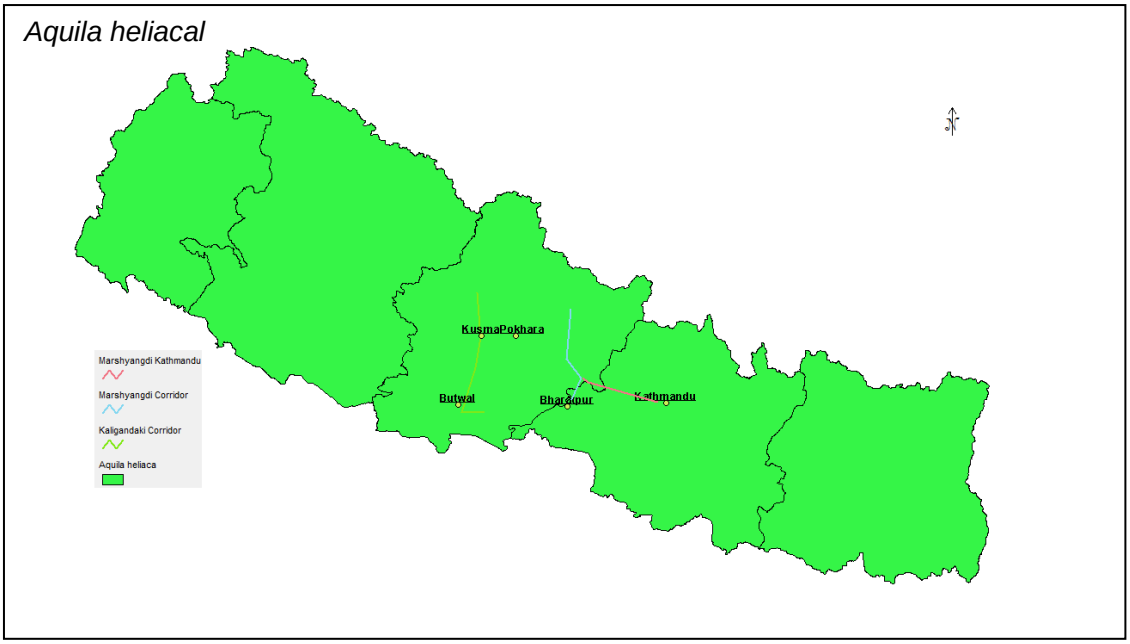


Birds

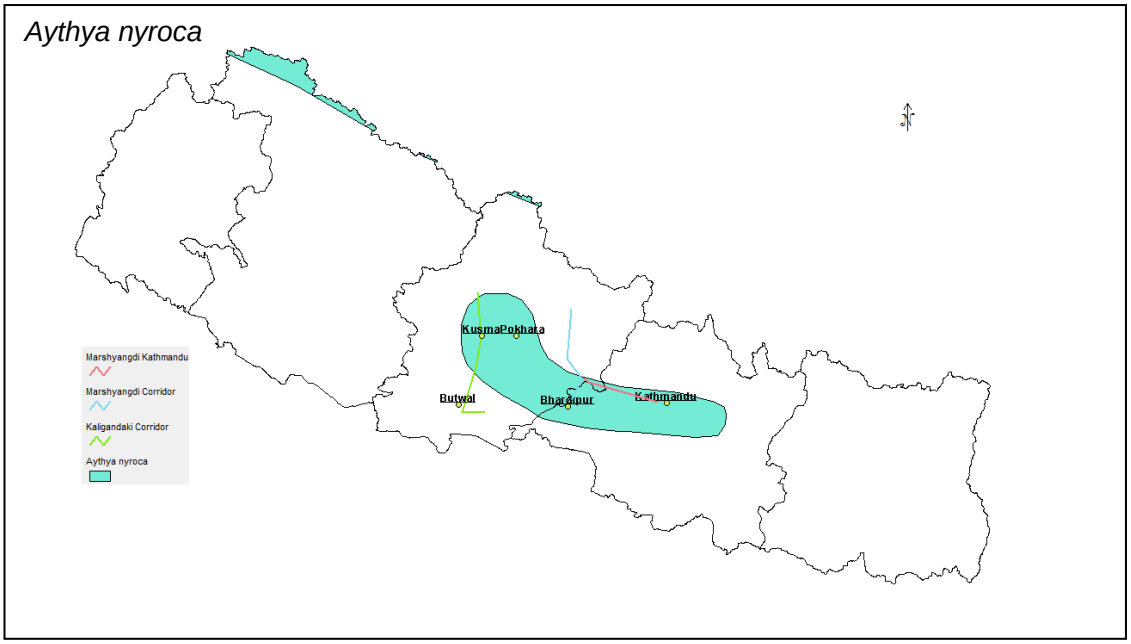
Aegypius monachus (Cinerous Vulture)



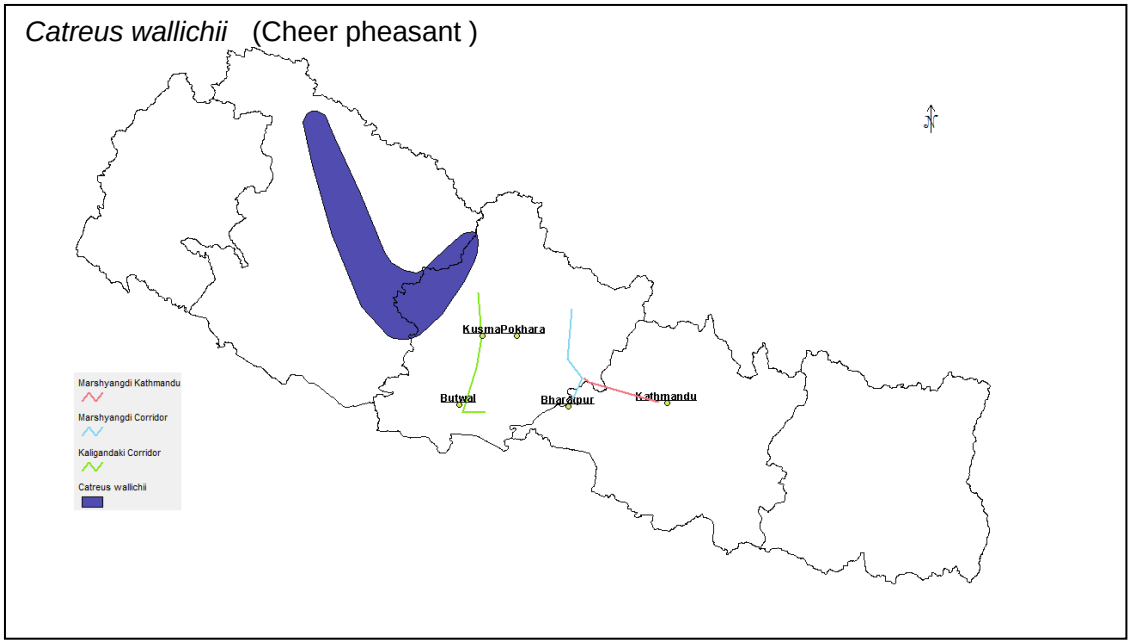
Aquila heliacal



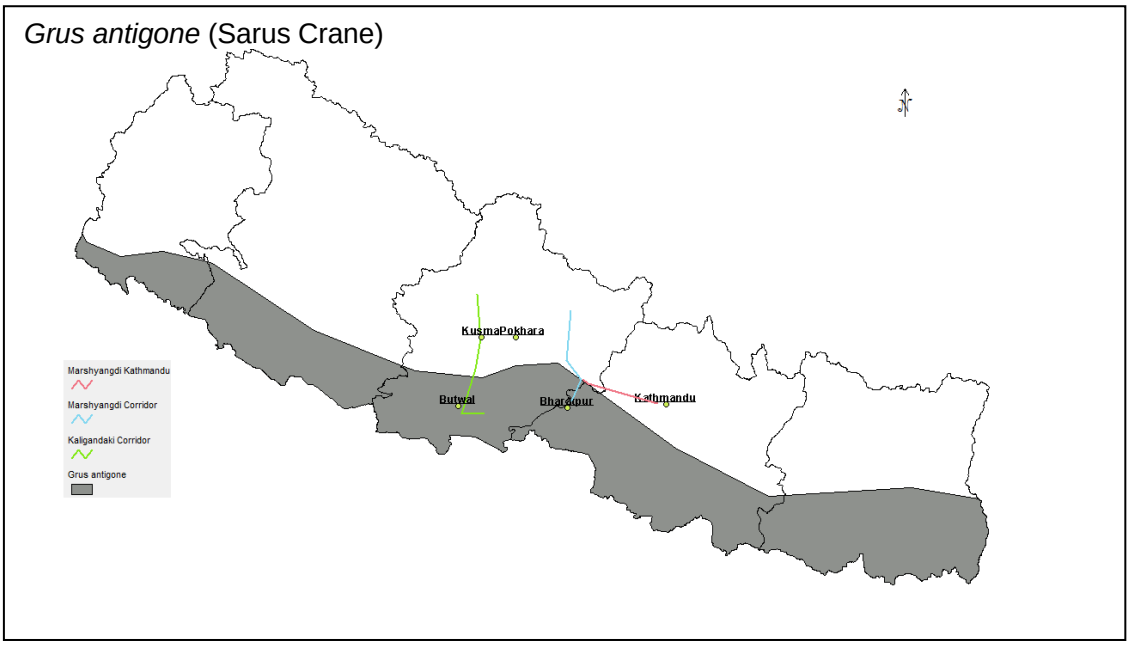
Aythya nyroca



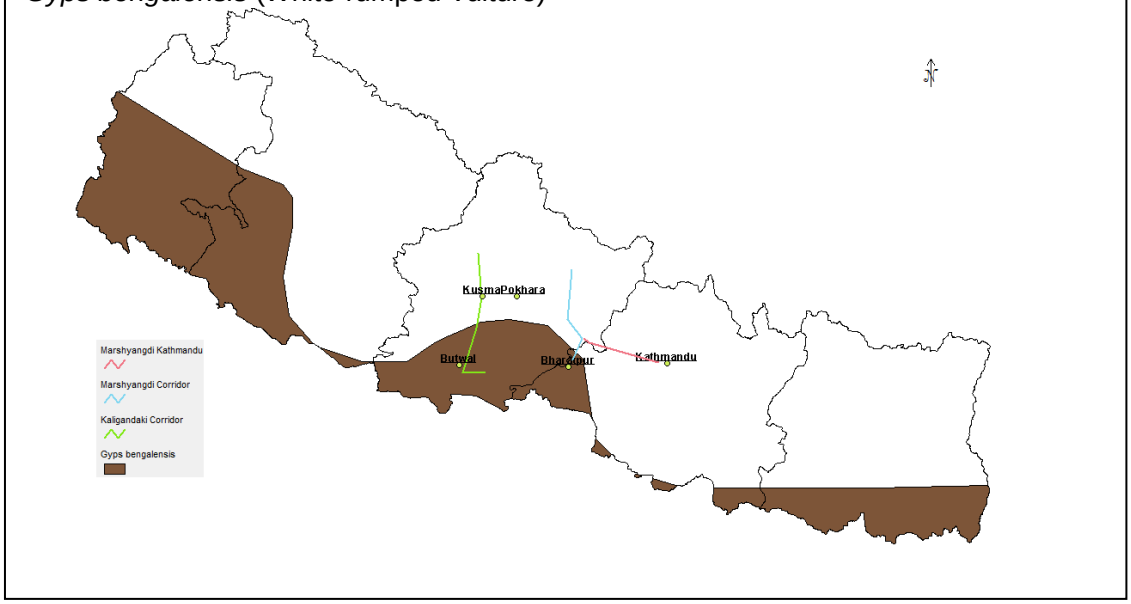
Catreus wallichii (Cheer pheasant)



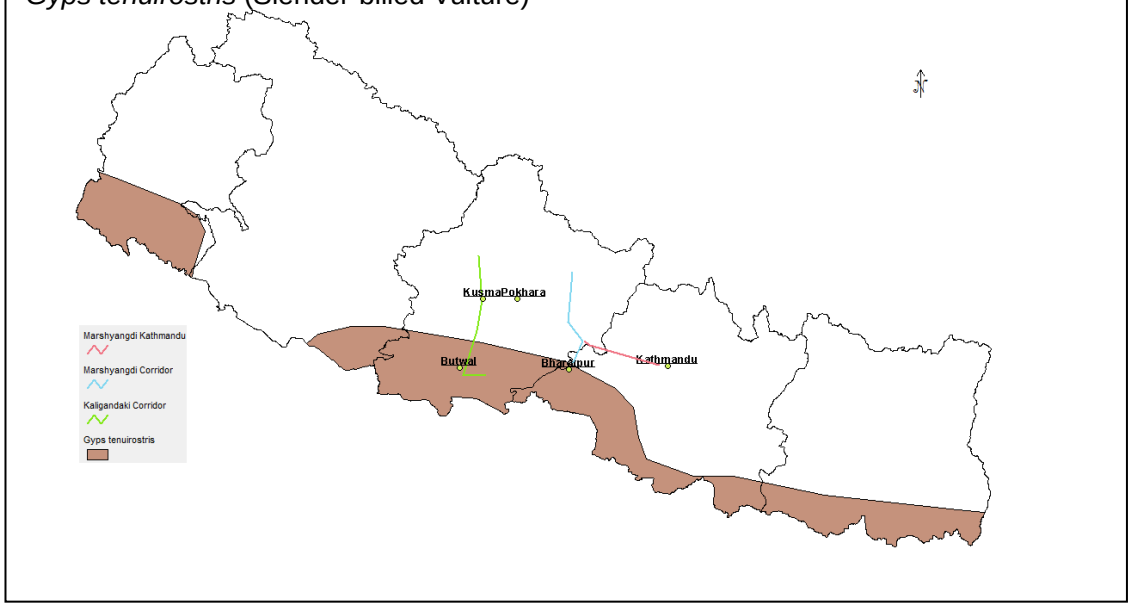
Grus antigone (Sarus Crane)



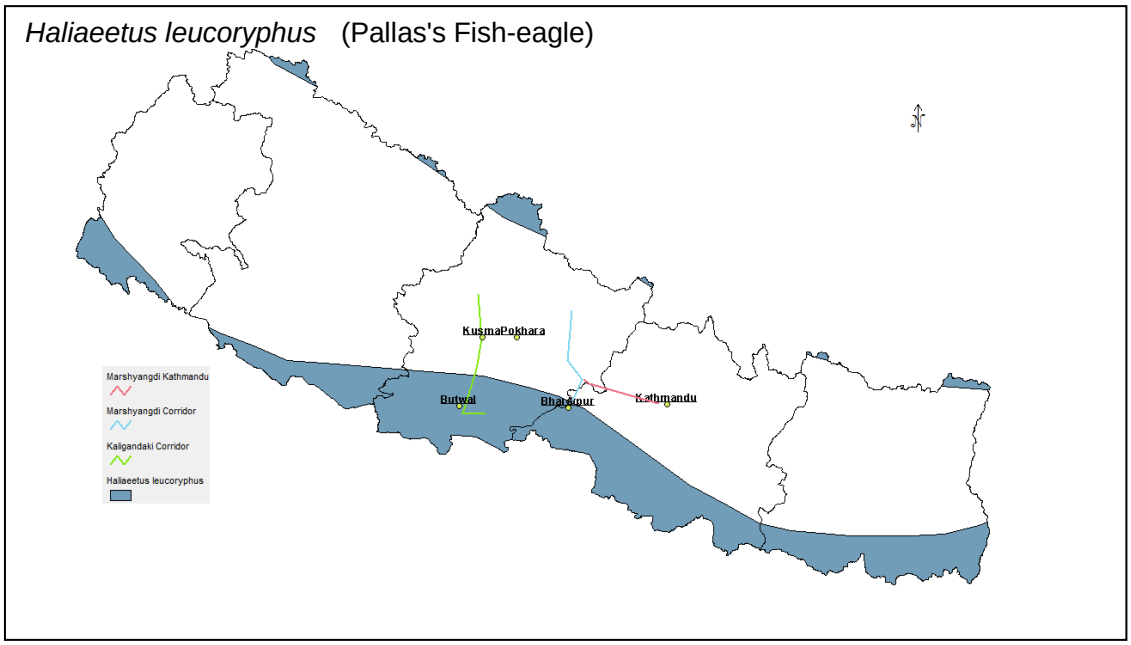
Gyps bengalensis (White-rumped Vulture)



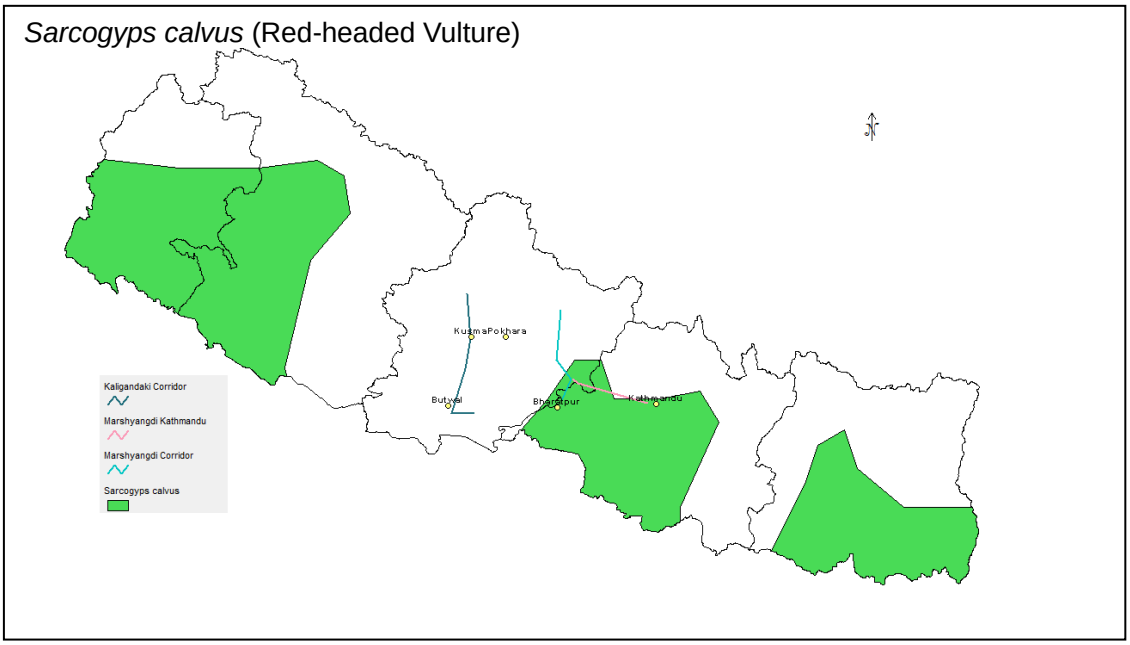
Gyps tenuirostris (Slender-billed Vulture)

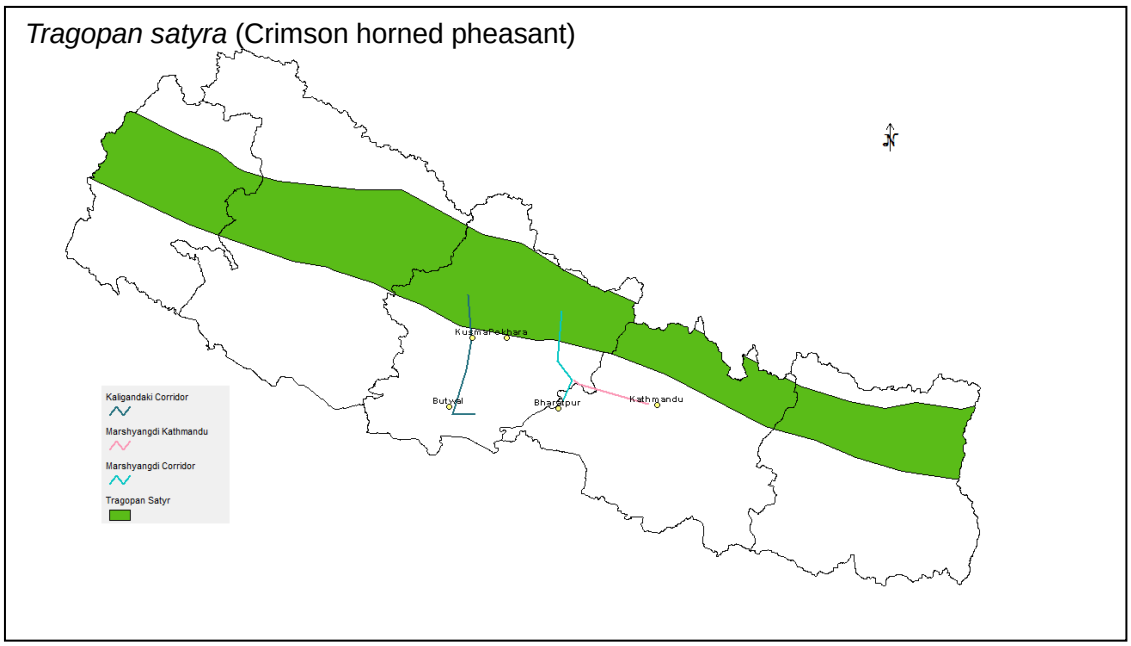


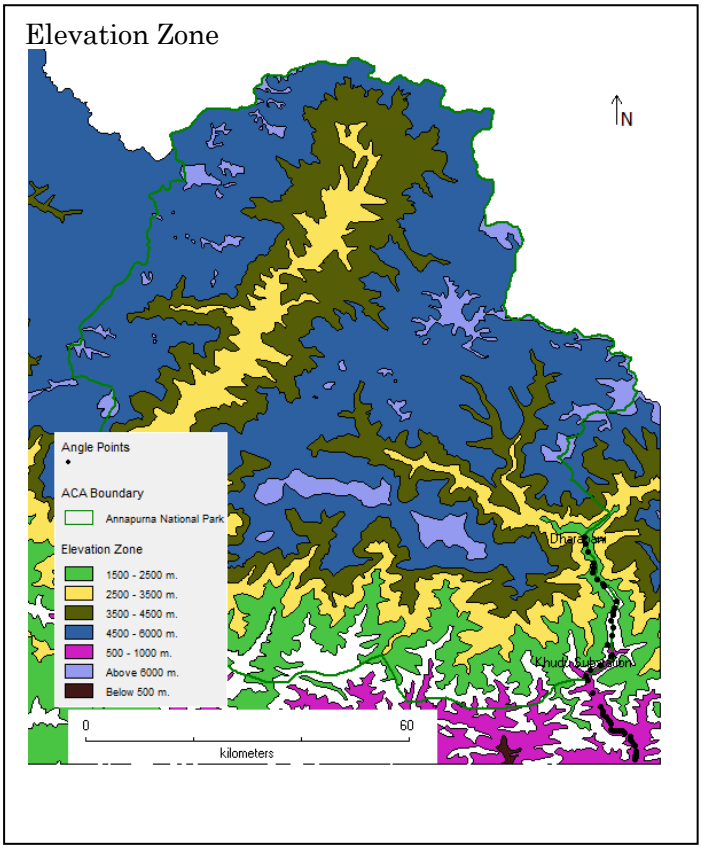
Haliaeetus leucoryphus (Pallas's Fish-eagle)



Sarcogyps calvus (Red-headed Vulture)







Source: (ICIMOD, 2008), (IUCN, 2010), (Birdlife International, 2010)

Appendix 3: Ongoing and New Donor-Funded Activities with Indirect Offsets to the Project

Project / Description	Time Line	Funding ($) / Source	Relevance to Conservation Area (and Climate Change)
Hariyo Ban Project This program aims to: i) reduce threats to biodiversity in target landscape(s); ii) build the structures, capacity and operations necessary for an effective sustainable landscapes management, especially reducing emissions from deforestation and forest degradation (REDD+) readiness; and iii) increase the ability of target human and ecological communities to adapt to the adverse impacts of climate change.	August 2011 to 2016[107]	TBC (approx. US$30 million) / USAID[108]	Reduce threats to biodiversity and vulnerabilities of climate change in Nepal. The project works in Terai Arc Landscape and Chitwan Annapurna Landscape also includes Annapurna Conservation Area
Reducing Climate change vulnerability of poor The New programme will support the development of climate adaptation evidence and pilot approaches to improve adaptive capacity of communities. The programme will focus on vulnerable groups, safeguarding their livelihoods and creating employment, whilst reducing the vulnerability of people.	2009-2014	10 m £ / DFID	Building climate resilience and promoting low carbon development pathways
Establishment of Regional Flood Information System in the Hindu Kush- Himalaya The project, with ICIMOD, is intended to minimize loss of lives and livelihoods by providing timely warning information and thus reducing flood vulnerability in the HKU region, in particular in the Ganges – Brahmaputra – Meghna and Indus river basins through sharing meteorological and flood data and information amongst six regional partner countries, Bangladesh, Bhutan, China, India, Nepal and Pakistan.	2009 – 2013[109] (3 years)	$US 2.9 million / Finland	Enhanced technical capacity of partner countries would improve flood forecasting, disaster preparedness and water related hazards that are expected to occur as a result of climate change. Sharing of timely and reliable flood warning systems would improve the lead time for taking risk reduction measures in the region.
Hazard Risk Management Program: Nepal To mainstream disaster reduction in poverty reduction strategies and supporting national capacity to deal with natural disaster risk.	2014-2016	US $83.8 million / IFRC, USAID, UNDP[110]	*Building Resilience* The Global Facility for Disaster Reduction and Recovery (GFDRR) mainstreams disaster reduction in poverty reduction strategies and supporting national capacity to deal with

[107] http://carenepal.org/opportunities/18_TOR%20Biophysical%20Condition%20of%20Critical%20Watersheds%20updated%20on%2022%20March%20201....doc
[108] http://www.theredddesk.org/sites/default/files/english_brochure.pdf
[109] http://www.finland.org.np/public/default.aspx?contentid=194229&contentlan=2&culture=en-US
[110] https://www.gfdrr.org/sites/gfdrr.org/files/publication/GFDRR_Work_Plan_Endorsed_2013.pdf

Project / Description	**Time Line**	**Funding ($) / Source**	**Relevance to Conservation Area (and Climate Change)**
			climate-change natural disaster risk.
Multistakeholder Forestry Programme-Nepal The Multistakeholder Forestry Programme aims to contribute to inclusive economic growth, poverty reduction and tackle climate change	2010-2021	20 million£ / DFID	Promoting growth Enhanced assets of rural communities through more equitable, efficient and sustainable use of forest resources and better forest sector governance leading low carbon development pathways and creating green jobs.
Enhancement of Sustainable Production of Lokta Handmade Paper in Nepal The project aims to the production of "Lokta" paper and its production as sustainable economic activities, reducing the social and environmental challenges associated with the production of paper and paper products, as well as to increase the earning of the marginalized farmers and small scale entrepreneurs.	2009 - 2013	US$ 1.8 Million / EU	*Building Resilience* Sustainable exploitation of natural resources, preventing further deforestation, finally reducing emission of the GHGs (CO2) emission during the production processes of hand made paper and its products.
Forest Resource Assessment in Nepal (national forest inventory) The project is designed to obtain forest information at national scale concerning Non-Timber Forest Products, Trees Outside Forests, carbon content, forest biodiversity, human and biotic pressure and the soil characteristics among others as elements of the forest characteristics	2009 -2014 (5 years)	US$ 6.8 million / Finland	The project flags out the opportunities that exist for generating financial resources through carbon trading supporting Clean Development Mechanism (CDM) projects, supporting "Reducing Emissions from Deforestation and Forest Degradation" (REDD) mechanism, different climate change adaption and mitigation mechanisms and through payment of environmental services. The project outputs can be valuable tools to monitor climate change.

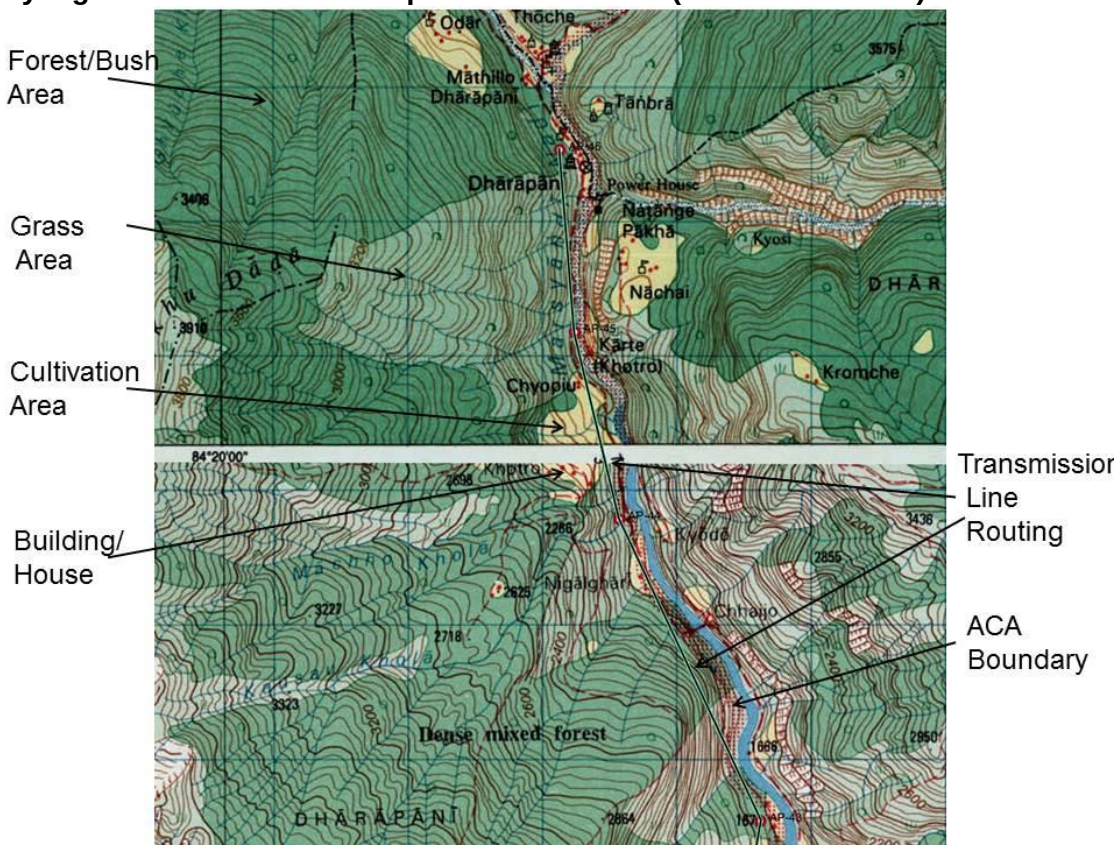
Project / Description	**Time Line**	**Funding ($) / Source**	**Relevance to Conservation Area (and Climate Change)**
Advise to Energy Efficiency (Nepal Energy Efficiency Programme)[111] A Technical cooperation programme for eight years with the objective to broaden public and policy understanding to use energy efficiently to balance the energy demand and supply and hence contribute to a sustainable energy management and climate protection.	2009 bis 2017	US$ 5.4 Million / Germany[112]	The projects use of energy efficiently helps conserves environment and climate.
Biogas Two biogas operations are being supported to increase access to modern energy sources in the rural and peri-urban areas of Nepal	2006-2015	US$7.0 million TF Grant / World Bank	*Promoting Growth* Biogas reduces global emissions of carbon dioxide, a greenhouse gas.
High Mountain Agribusiness and Livelihood Improvement (HIMALI) Project (ADB Grant 0248) The project will assist farmers and downstream enterprises to strengthen linkages, taking advantage of the gradual improvement in infrastructure, to realize the existing demand for mountain products.	2011 – 2017	US $20,000 / ADB – ADF Grant	*Sustainable economic development* The project will support agribusiness and value-chain development in 10 districts, including the Manang and Mustang District which covers part of the Annapurna Conservation Area

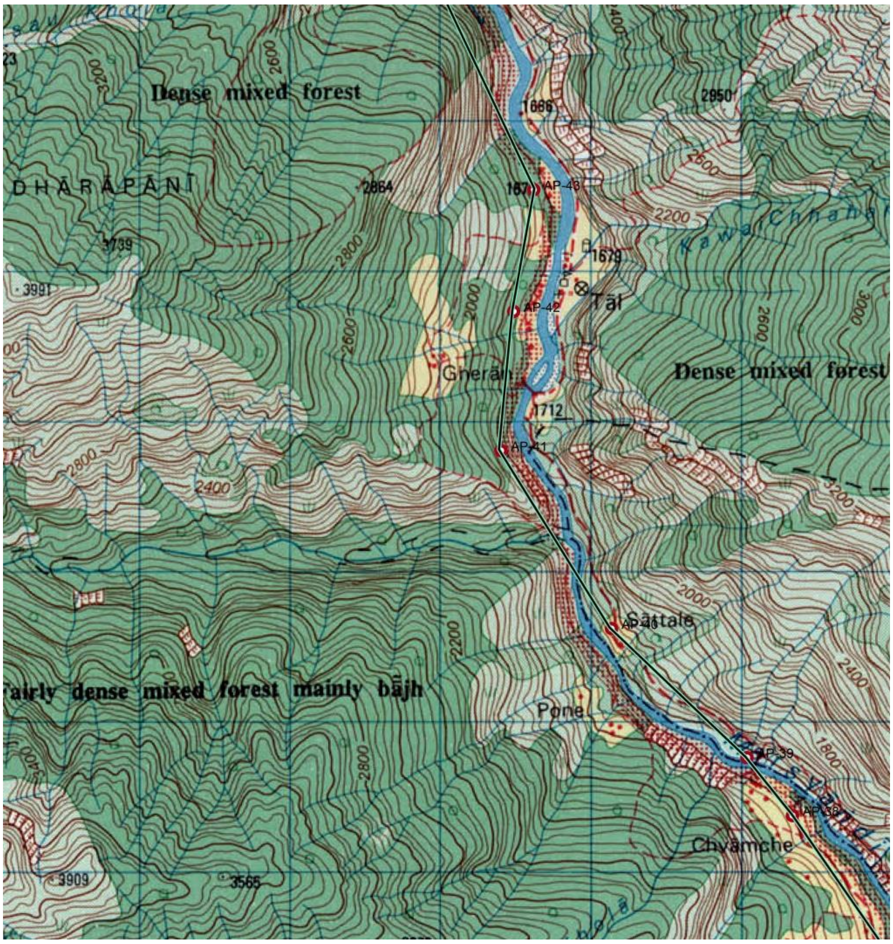
Source: Nepal. 2010. *Nepal: Strategic Program for Climate Resilience*. Proposal prepared under the Pilot Program for Climate Resilience. Projects are from Annex 2: Summary of Climate Change and Associated Projects Supported by Developments Partners.
The ADB HIMALI project information is from ADB project database.

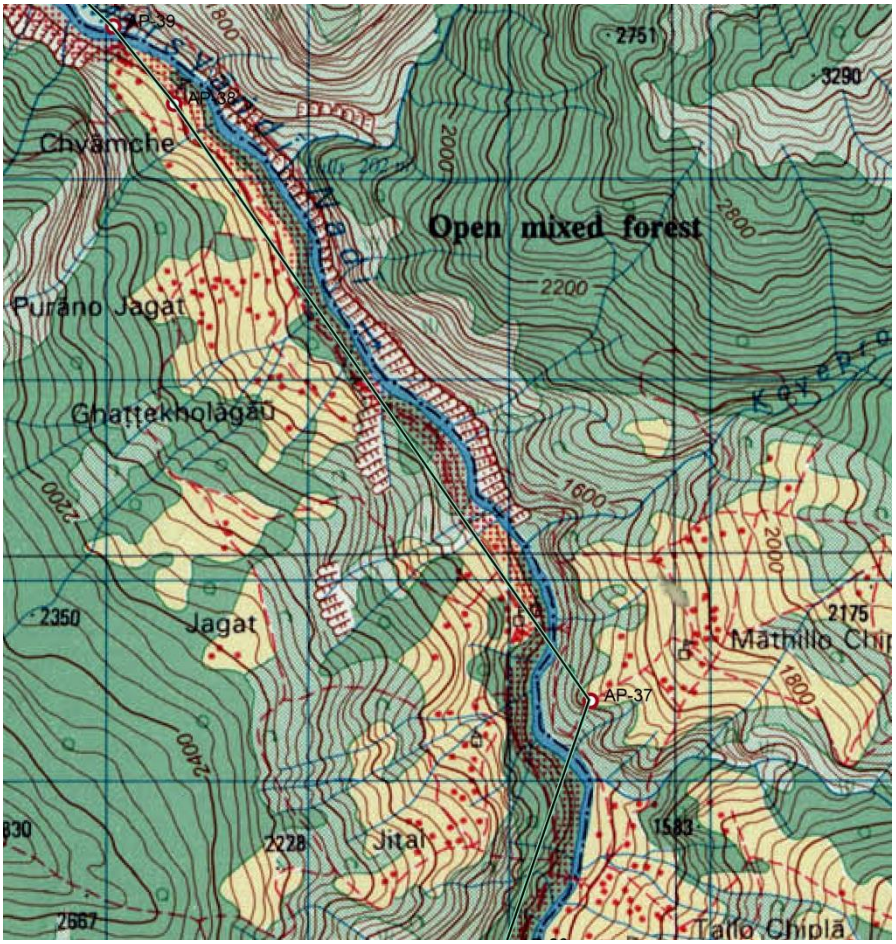
[111] http://wecs-neep.gov.np/article-about
[112] http://www.aiddata.org/content/Project?id=50068358

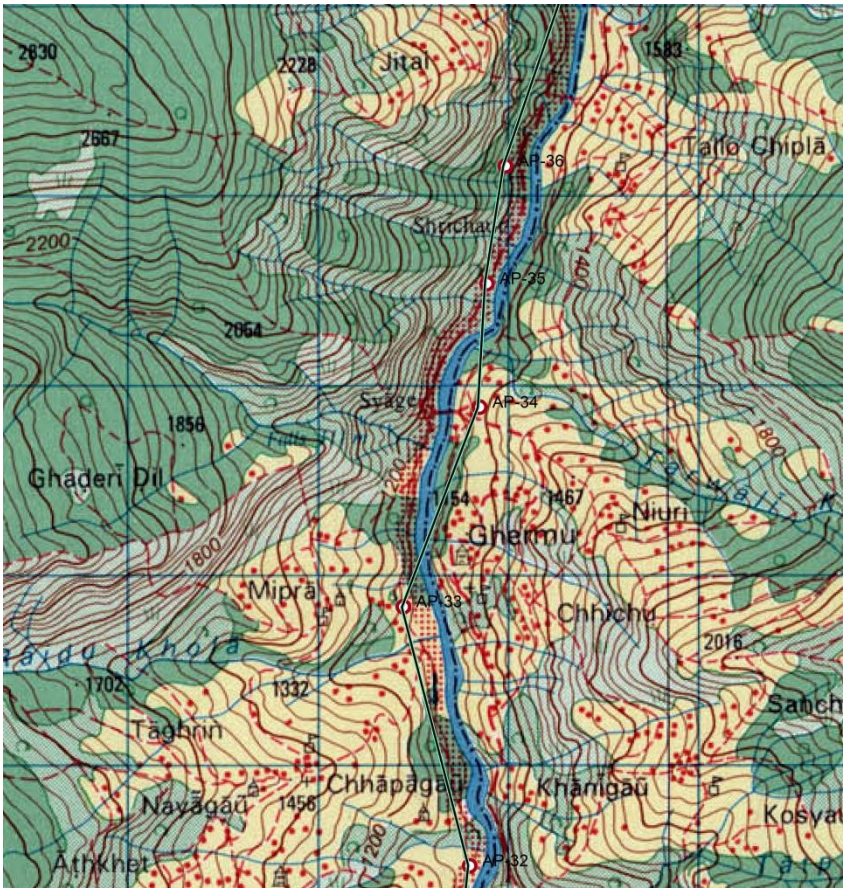
Appendix 4: Routing Map of Marsyangdi Corridor and Kaligandaki Corridor through ACA and December 2013 Field Visit Site Photos (Routing Map Source: NEA Survey Report)

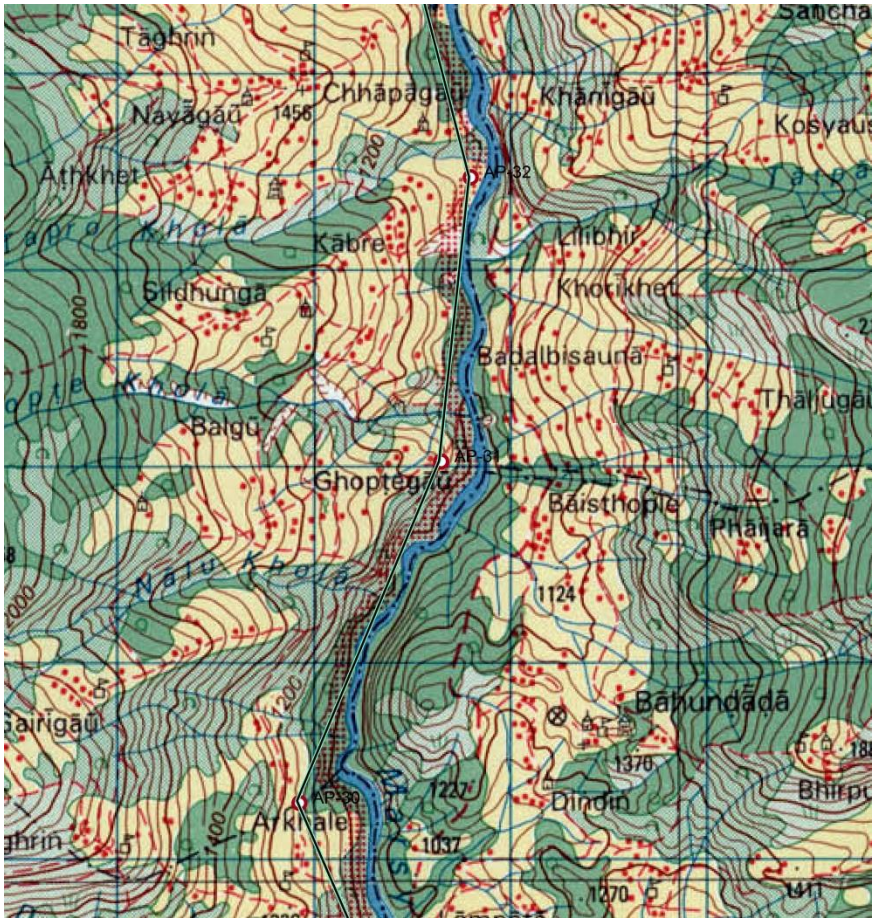
Marsyangdi Corridor from Dharapani to Khudi VDC (East side of ACA)

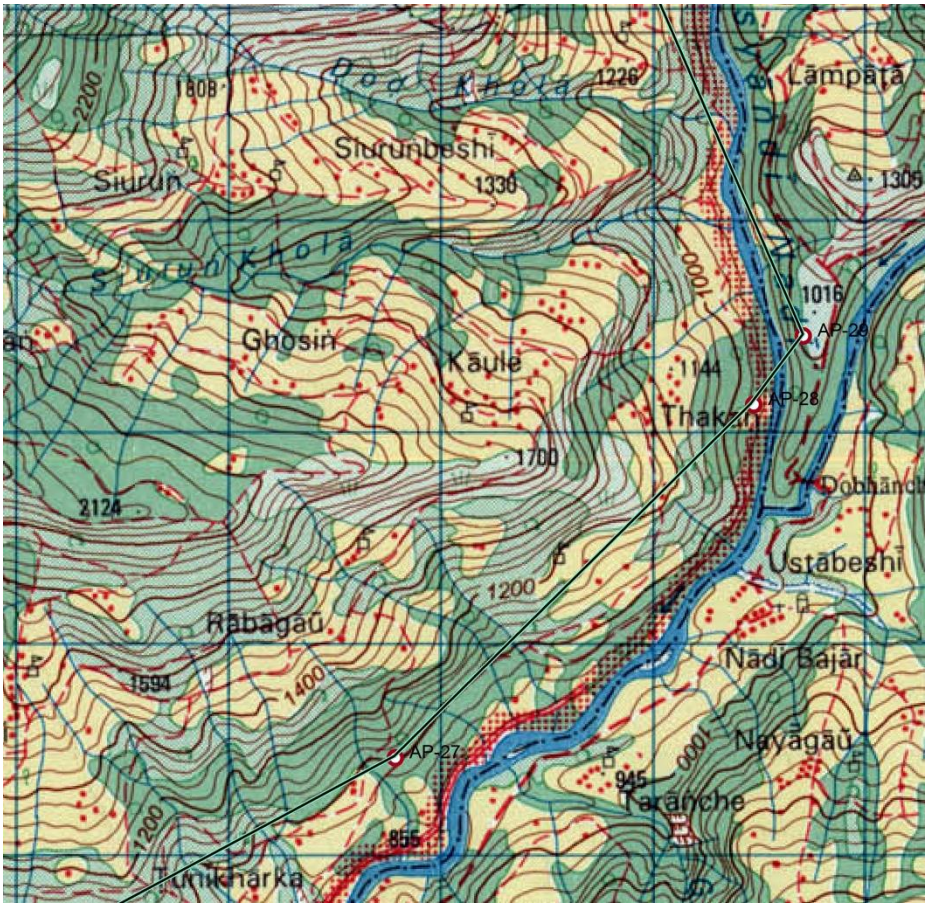


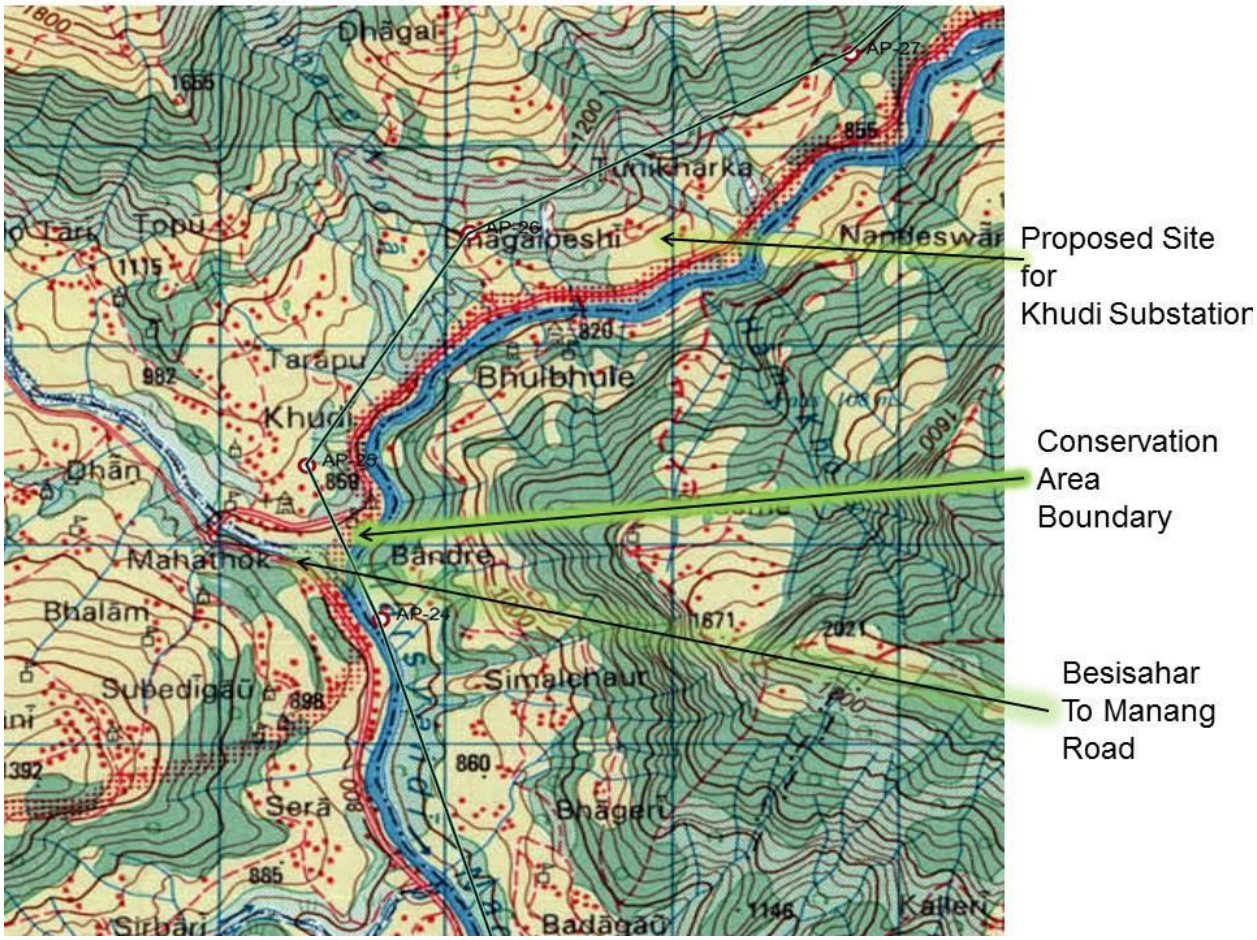

Dense mixed forest
DHĀRĀPĀNĪ
2864
3739
3991
1666
2950
AP-43
2200
1679
Tāl
AP-42
Gnerān
Dense mixed forest
1712
AP-41
2400
2800
2600
2000
Sāttale
Fairly dense mixed forest mainly bājh
Pone
AP-39
1800
2400
Chyāmche
3909
3565


AP-39
AP-38
AP-37
Chyamche
Purano Jagat
Ghattekholagau
Jagat
Jital
Open mixed forest
2751
3290
2350
2175
2228
1583
2667
2000
2200
2400
1600
1800
2800

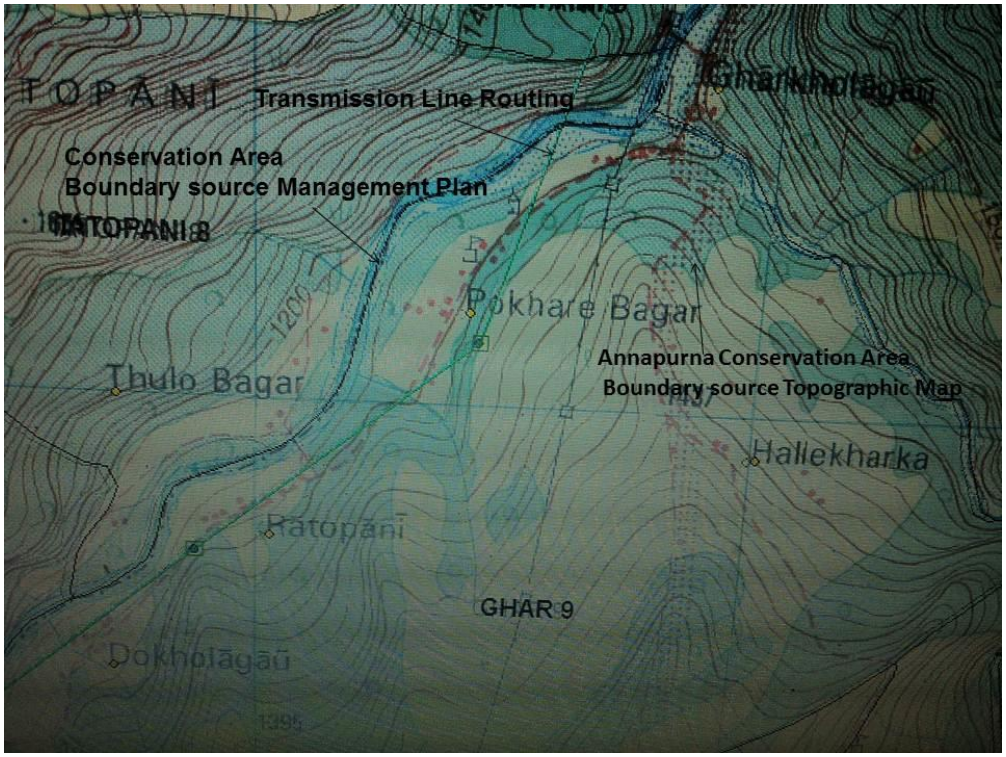

2630
2228
Jital
1583
2667
Tallo Chiplā
AP-36
Shrichaur
2200
AP-35
2064
Syāge
AP-34
1858
Ghaderī Dil
1800
1467
Niuri
Ghermu
Miprā
AP-33
Chhichu
2016
1702
1332
Sanch
Tāghrin
Chhāpāgāu
Khāmigāu
Navāgāu
1456
Kosya
Āthkhet
AP-32

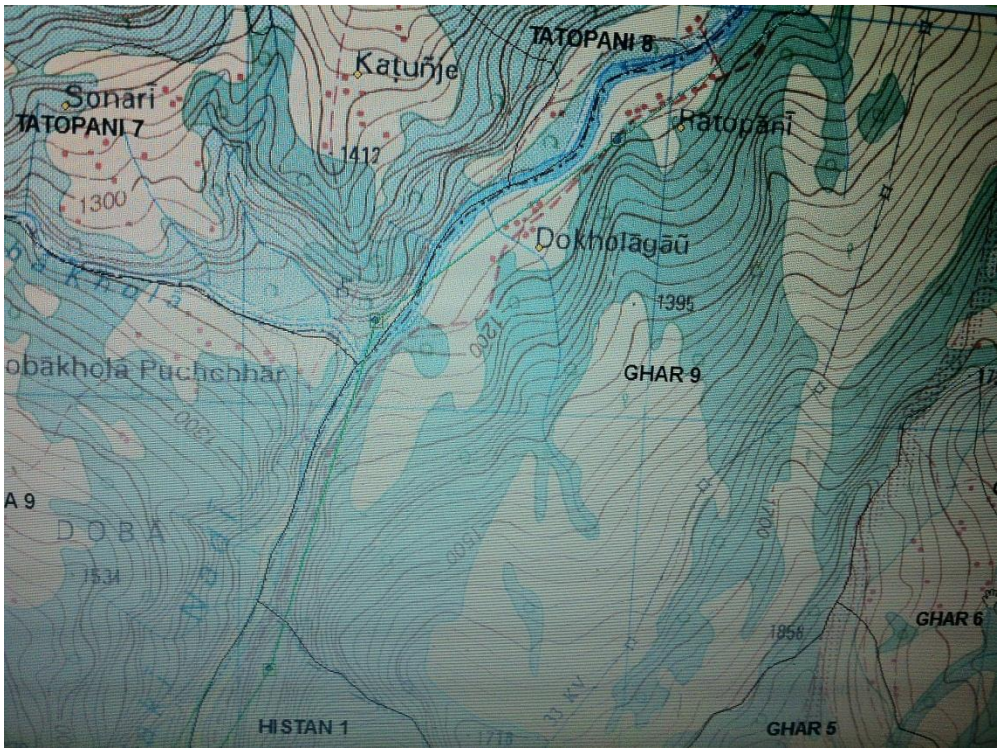

Tāghrin
Navāgāū
1456
Chhāpāgāū
Khānigāū
Kosyaus
Āthkhet
AP-32
Kābre
Lilibhir
Khotikhet
Sildhunga
Badalbisaunā
Thāljugāu
Balgu
AP-31
Ghoptegāū
Bāisthople
Phāhārā
1124
Bāhundādā
1370
Dindin
Bhirpu
AP-30
Arkhale
1037
1270
1411


Lāmpāṭā
1226
1305
Siurunbeshi
1330
Siurun
1808
2200
Siuruā Khola
1000
1016
AP-29
AP-28
Ghosiṅ
Kāule
1144
Thakaṅ
1700
2124
Dobhāndh
Ustābeshī
1200
Rābāgāū
Nādī Bajār
1594
1400
AP-27
Nayāgāū
945
1000
Tarāṅche
855
1200
Kunkharka



Kaligandaki Corridor at Ghar VDC (west side of ACA)


TOPANI
Transmission Line Routing
Conservation Area
Boundary source Management Plan
TATOPANI 8
Pokhare Bagar
Annapurna Conservation Area
Boundary source Topographic Map
Thulo Bagar
Hallekharka
Ratopani
GHAR 9
Dokholagau


TATOPANI 8
Katuñje
Sonari
TATOPANI 7
Ratopani
Dokholagau
GHAR 9
HISTAN 1
GHAR 5
GHAR 6

Pictures from Site Visit

Figure 1: Marki Chowk Substation Site

Figure 2: Marki Chowk Substation Site

Figure 3: Udipur Substation Marsyangdi Corridor

Figure 4: Routing Close to Proposed Udipur Substation Site in Marsyangdi Corridor

Figure 5: Construction of Upper Marsyangdi A near Khudi Substation site. Photo taken on Besisahar-Manang road which is inside the ACA.

Figure 6: Khudi Substation Site in Marsyangdi Corridor – Site is just inside the ACA

Figure 7: Dana Substation Site Kaligandaki Corridor. ACA is visible in background of photo.

Figure 8: Kaligandaki Corridor - Early Stage Construction Activities for Mistri Khola Hydro. Site is about 2 kilometers north of Tatopani Hot Springs. Land on left side of river is in the ACA (see next photo).

Figure 9: Mistri Khola Hydro Power Construction Kaligandai Corridor

Figure 10: Kushma Substation Site Kaligandaki Corridor

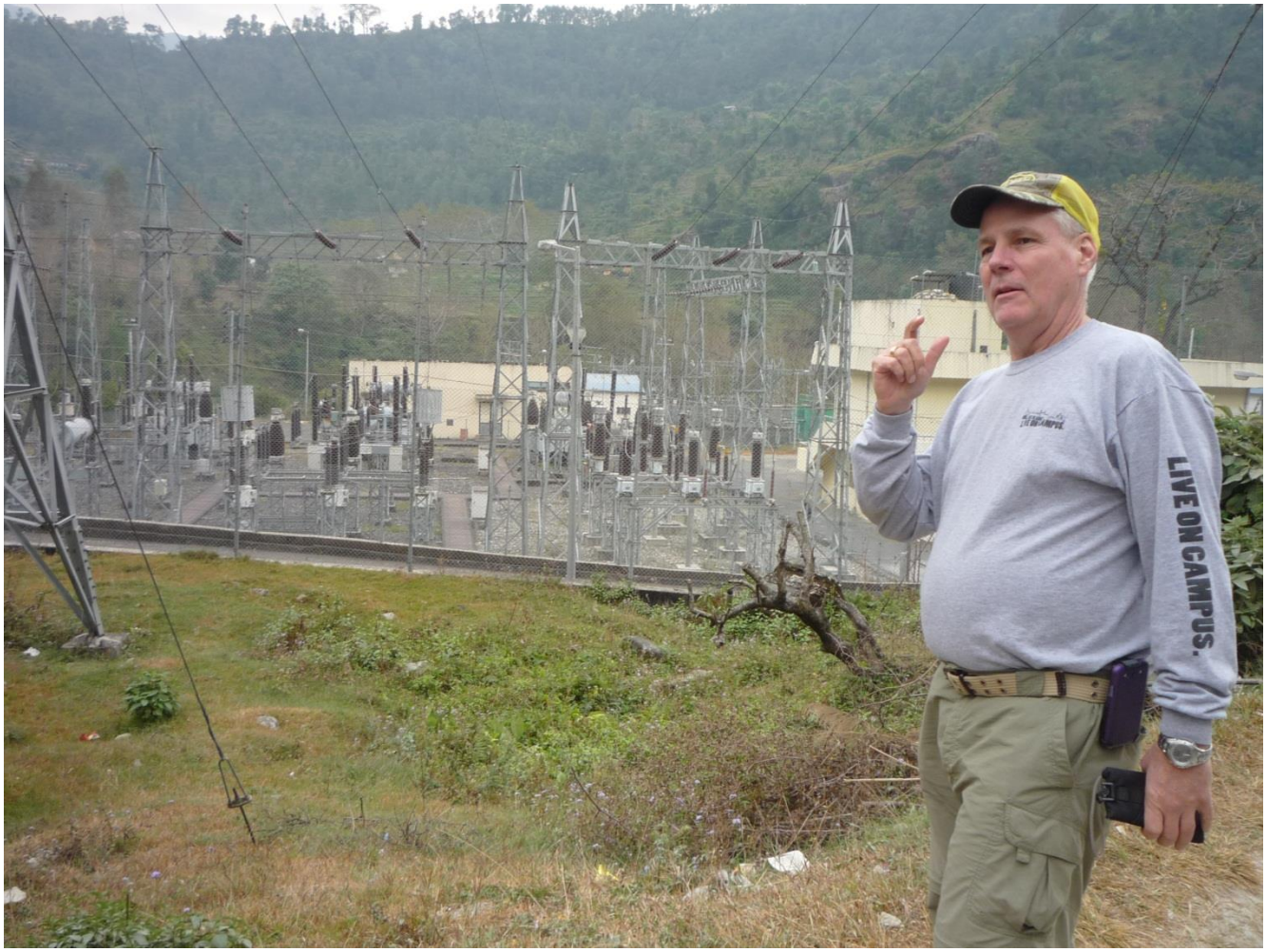


Figure 11: 132/33 kV Substation Facility on Modi River. Modi hydroelectricity plant (HEP) powerhouse is underground in background of photo. This substation is similar in scale to those proposed for the project.

Figure 12: Common Run of River Hydro Plant – Diversion structure of Modi HEP

Figure 13: Proposed Site for 132/33 kV Samundratar Substation

Figure 14: Routing for Samundratar Trishuli 132kV Transmission Line

Figure 15: Trishuli Routing at Ghermu VDC

Figure 16: Trishuli 3B Hub Site

Figure 17: Trishuli Routing near Betrawati

Appendix 5: Summary Findings on Public Consultations

Table A5.1: Summary of Marsyangdi- Kathmandu 220 kV Corridor

Issues Discussed	People's views and perceptions
General Perception about Project	Most of the communities were not aware of the proposed transmission line passing through their areas. Some communities were aware of the technical survey but not sure what is going to happen in their communities in near future. Overall, it was through the research teams that they first heard about such electricity projects that would be implemented across their communities.
Support of local people for proposed project	Community response patterns were diverse. At one end, the communities expressed their fullest support in view of the projects' national importance. They believed that such projects would contribute to country's development such as expansion of industries and reduce the heavy import of fuel from third countries, increase the rate of rural electrification. They also hoped that the new projects will improve their electricity supply, reduce load shedding which is now more than 12 hours a day. However, they requested the transmission line should not pass from the settlement. At the other end, some communities were concerned about the loss of crops, house etc during construction. They expressed their willingness to support provided that there should be any adverse impact on their assets, income and livelihood and should compensates adequately for such losses in cash.
Critical issue and concern by the local people for the project	Most of them in the opinion that if suitable environment is made for the reuse of existing productive land, there will be no problem. Some of the communities raised issues/concerns such as (a) fear of decreasing the land values when electricity lines run over their land or polls/towers installed in the middle of a land; (b) loss of agricultural production due to the construction work; (c) a few communities believed that living closer to electricity lines would have negative impact on their health (d) some communities requested that they should be informed and involved in each project activities.
Criteria liked to see during project design, operation stage and construction	The projects should avoid/minimize harm to residences, plantations, cultivations, other forms of livelihoods, religious and other places of community importance such as schools play grounds etc. Line routes should avoid running over houses. Necessary precautions must be taken to ensure safety of people during project construction.
Employment potential in the project	Majority of the rural communities expressed that the project will bring lot of employment opportunities to local people. Some of the communities request that they should be involved not only in unskilled labour work but also in the administrative and supervisory work. Though the skilled labour are unavailable in the communities, they should be provided training during project construction. They are in opinion that the project will offer only short term employment during construction. The project should give them long term employment. They requested that the

Issues Discussed	People's views and perceptions
	contractors should use the local manpower, if not sufficient, they can bring from outside. They hope that the economic activities of the communities will increase from which they can be benefitted by establishing the shops like foods, tea, grocery, fast food for the workers during construction.
Ethnic Minorities	The communities consists of multi – ethnic group like Indigenous People (IP), non-IP and disadvantaged / ethnic minority. The non –indigenous people are Brahmin/Chettri where as the the indigenous people are Chepang, Magar, Gurung, Shrestha, Bhujel, Darai, Lama, Majhi, Tamang. and ethnic minority people like Biswakarma, Damai, Kami, Sarki Pariyar were found in the community. Most of these ethnic groups were present at the consultations.
No of shops/commercial establishments	None of the communities had any large scale business enterprises. Almost all the communities had retail grocery, tea shops. whose numbers ranged between 210 and the total shops in the whole TL alignment ranged between 60 - 100. Among the commercial enterprises were rice and flour grinding mills, LP Gas assembling unit, saw mill, furniture shops, poultry farm. But they were found only in a few communities.
Number of industrial units	One Gorakhkali Tyre factory and some stone processing industry (turned to the small stone for gravel on the road) were seen. Other such big industrial units were not found in the communities.
Socio economic standing: land use, cropping pattern	Maize, millet, potato, paddy cultivation was the major source of livelihood of the families. However, paddy cultivation was restricted to a single season of the year only in rainy season. Most of the families possess some kind of animal husbandry like goats, pigs poultry. But few households have the cattle, buffaloes kept in their house for making the compost manure and for ploughing into the field. The extents of land cultivated by the farmers ranged between 5 ropani – 30 ropani (0.25 ha- 1.5 ha). Incomes of the communities were supplemented by remittances from outside whose family members worked mostly in the gulf countries and India in different office, factories, construction work etc. Some family members have been employed in the government and private sector too. On an average 1 male members of the family were temporarily migrated to other countries for the work. The number of female migrant is very minimal.
Sources of irrigation	Most of the agricultural activities in the communities were rain fed. In some settlements they were dependent on the small irrigation canal carried out from the small stream and river like Tapol khola, Fudauri khola, Biju khola (under construction), Kali khola. In most the communities they have two crops in one year.
Access to Forest Land and Use	The government of Nepal has the policy of handing over the government forest to Forest users groups formed under the

Issues Discussed	People's views and perceptions
	Community Forestry programme. So in most of the places, the forest is managed by the community such as Lamkani Devi, Khor Bhajung, majuwa, salleri, maha Laxmi, Kalika Devi, rajdevi, Mathillo Ghyaga, Jaldevi Community Forests. None of the communities consulted had extensive dependence on forest resources. Several communities were located far away from forest reserves. The committee can decide to collect the firewood and the wastage fodder for their household consumption. However, they have to plant new trees manage the forest under their jurisdiction.
Current rates for agricultural land	Prices of agricultural land were subject to variation depending on several criteria e.g. (a) its use - whether the land is used for paddy cultivation or highland crop cultivation; (b) availability of irrigation facilities; and (c) location – whether the land is situated closer to access roads or in the interior. In adjoining the road the land value ranges from NRs. 20,000,000 to Rs. 40,00,000 for 1 Ropani (0.051 ha). Along the road, due to scarcity of land even the land price is not fixed, the owner asked whatever he like. But the price for agricultural land outside the road ranges from NRs. 20,000 to NRs. 1,500,000 per ropani (0.051 ha).
Sources of power supply	Majority of the communities were dependent on government sources Ie. NEA for electricity supply.
Sources of electricity	Government grid is the only source of electricity for the communities.
Average amount of electricity used by per household per day	The quantum of electricity used by a household varied. Households that used electricity only for the purpose of lighting and sometimes for operating a TV as observed in several villages consumed 1-3 units per day. Households that used electricity for lighting as well as for operating electrical appliances such as TVs, refrigerators, irons, and water motors (which were the appliances commonly used) consumed 3-5 units per day.
Unit Rate	The unit rate varied along with the number of units consumed [according to variable standard rates set by NEA]. Households that consumed Up to 20 Unit of 5 ampere per month had to pay Rs.80/- per unit whereas households that consumed more than 20 units had to pay above Rs.6/- to Rs.8/60- per unit up to 250 units per month.
Average total monthly expenditure per household on grid electricity	The average monthly bill varied between Rs. 80/- to Rs. 200- per month.
Other non grid electricity to use in your village and expenditure	None of the communities consulted reported having used non-grid electricity sources in their villages.

Issues Discussed	People's views and perceptions
Source of drinking water	Some piped water/tap supply found in some communities. They bring the water through pipe from the water source in the hills. This type of piped water facilities were constructed under the assistance of UNICEF, NEWA (NGO) Otherwise, majority of the families in the communities depend on river and stream for the drinking water supply.
Shortage of water	Families did not experience a major shortage of water as there were several sources to collect water such as rivers, streams, etc. in rainy season periods. However, in the dry season, people experienced difficulties in accessing water for domestic use. Some had to travel up to 1 Km to bring water for their domestic use.
Negative impact on food grain, availability /land use	In general, people did not see any adverse impact on food/grain availability. However, they cautioned that if electricity polls/towers are installed in the paddy fields or other cultivable land, it would reduce the cultivable area of the farmers.
Will project cause landslides or soil erosion	They are not aware of the landslides or soil erosion due to the construction of transmission line. If it happens, it should be controlled properly.
Will project cause widespread imbalance by cutting fruit and commercial trees in the locality	People were unable to give a precise answer to this question as they did not know the exact extent to which the trees would be cut-down. The majority did not foresee such an imbalance. However, they cautioned that if the project cuts down valuable commercial trees e.g. timber such as *Sal trees* and fruit trees such as citrus, banana, Papaya, mangoes in significant numbers it would drastically affect the livelihoods and incomes of families who are dependent on those trees.
Will project cause health and safety issues	Some others believed that living closer to electricity lines can harm the health condition. But the majority did not foresee any health or safety issues. Installing towers in the middle of settlements would raise safety issues particularly for children. And communities suggested that such towers should be far from the settlement.
Resettlement and land acquisition	NEA has identified government owned barren land for a majority of the proposed grid stations and towers, but some lines required to pass from the private land. Therefore, it should not cause any loss of private properties or population displacements. In the case of private properties identified for the construction of grid stations and towers, all the land owners are 'willing sellers' on market price. Communities consulted could recall the land acquisitions for previous Gorakhkali Tyre Industry, Marsyangdi132 kV transmission line. It was almost 20 to 30 years ago, some of them had received Rs. 5,300 to Rs 12,000 per ropani on Gorkhakali Tyre Industry and Rs. 9,000 for 4 anna of land for tower construction based on the location of land, up land low land. They have received compensation for AP and towers for Marsyangdi 132 kV line construction. In a few places they could recollect NEA paying compensation to families who lost valuable trees or plots of paddy land where towers were installed. They prefer market rate for valuation of lost assets to be compensated.
Protected areas	No protected areas were observed within the communities consulted.

Issues Discussed	People's views and perceptions
Health status	In some communities, they have access of a sub health within half to one hour of walk from their residence. In some communities they have to go Abukhaireni (Tanahu) or Jogimara (Dhading) for the health check up which will take about 1 to 2 hours by bus. But for the chronic and more acute disease they have to go either to Bharatpur or Kathmandu for the treatment. The district hospitals are not so much equipped for the treatment of chronic and more problematic diseases. Some communities complained of poor health services, lack of drugs and doctors. Private medical centres are very far away from their villages. Though private medical centres too were available within easy reach, they did not go to such places because they are more expensive.
Will project setting change migration pattern of animals	None of the communities were conscious of the presence of any migrant birds or animals in their localities and therefore did not foresee any impacts on such animals, birds or their habitats.
Poverty Level	A significant proportion (approximately 60%-70%) of the population in the communities consulted reported as having an *average* socio-economic status. This means that they were able to have three meals a day. The proportion of *poor* families in the communities accounted for 10-20 percent and they represented families who did not have a stable source of income and were largely dependent on casual labour work. The numbers of *very poor* families in the communities were negligible in most communities and constituted less than 5%.
Educational status	The literacy rate in general was high in all the communities. In some communities it was more than 90 %. In some communities the literacy level was reported between 60 to 80%. The younger generation in the rural communities had a higher educational level compared to their elders. The school drop-out rate was extremely low and most of the children pursued continuous education at least up to class 10. Economic difficulties in the families were the major reasons for some children to discontinue their education. Communities were also satisfied with the services provided by government schools. Education of children had been adversely affected during *Maoist* insurgency in Nepal from 1996-2006 (due to war and displacement).
Employment status	Majority of the people (more than 60 %) depend an agriculture in rural areas. However, some of them have been engaged in Gorakhkali Tyre industry, stone masonry industry. But their percentage is very minimal. About 30 % are seasonal labour in agriculture. Most of the young generation had gone gulf countries in search of employment. It has been reported that about 20 % youth have gone for foreign employment. Some of the community members were engaged in their own small shops like retail grocery, tea, food, vegetables sale shops. So the major sources of earning was remittance from their family members working outside the country. On the average, the unemployment and under employment ranges from 10-15 percent.
Migration pattern	Outward migration is comparatively high in rural areas than in

Issues Discussed	People's views and perceptions
	urban areas. Most of the young generation especially the boys have migrated for foreign employment especially in the gulf countries in search of employment.
Type of compensation expected	Almost all of the communities expected adequate cash compensation for any losses to their houses, land, plants, properties, cultivations and livelihoods.
Perceived benefits from project	Most communities were of the view that the proposed projects would benefit the country as a whole and would contribute to minimize the prevailing energy crisis, load shedding in the country. At micro level, they hoped that projects would provide electricity to non-electrified households in their communities and offer labour work and increase economic activities in the communities during construction.
Perceived loss	Some communities expressed their view that the project would leads to deforestation. So trees plantation programme need to be launched. The temporary loss of crops and trees of individual should be compensated by NEA.
Other organizations active in the area	Not many active community based organizations or NGOs were found in the communities consulted. In some communities CBO/ NGO like cooperatives, credit and savings, mothers group. youth organization were functioning in the rural areas. The communities refer the name of some NGO and INGOs like Focus Nepal, Shanti Nepal, SAPROS, SAHAS Nepal, RIMS Nepal, PAF, HEFFER International. Some vegetable, dairy n institutions were also assisting in in the promotion of vegetable farming, dairy farming in the community.
Village Committee	Since the dissolution of the local bodies (VDC, DDC) in 2002, these village development committees are functioning without elected people's leadership. VDCs, local bodies are the lowest units of the government's service delivery mechanism. The local bodies is now functioning merely by the government appointed employee who were mostly absence in the office. But a number of communities mentioned that if their communities faced a critical issue, the entire village or concerned people will get together and make a decision on how to address the problem. Several people mentioned that it was the local politicians who generally make decisions on community issues and gear the development programs and activities.
Usefulness of consultation	All the communities appreciated the consultation and sharing information on the transmission lines that would go through their villages and communities. This helped them to know about the project benefits, likely adverse impact on the community. Sharing information is important so that communities can support the implementing agencies to minimize adverse effects of the projects and increase the implementation efficiency.

Table A5.2: LIST OF PARTICIPANTS / PUBLIC CONSULTATIONS
Marsyangdi- Kathmandu Corridor

No.	Location	Date	Name of the participant	Status of the participant
Marsyangdi – Kathmandu Transmission Line 220 kV				
1	Simal Phant, Deaurali VDC, ward no. 7, Gorkha district	05.03.2014	S. Adhikari	Agriculture
			R.B. Adhikari	Agriculture
			K. Adhikari	Agriculture
			S. Karki	Student
			D. Khanal	Unemployed
			Devraj Khanal	Agriculture
			S. Khadka	Student
			M, Khadka	Agriculture
			B. Adhikari	Housewife
			B. BK	Agriculture
			B. Khanal	Business
			R. Bhujel	Agriculture
			P.B. Nepali	Agriculture
			A. B. KB	Agriculture
			B Khanal	Teacher/writer
			B. Shrestha	Teacher
2	Darai gaun, Deaurali VDC, ward no. 5, Gorkha district	05.03.2014	T. B Darai	Service
			S.B. Darai	Service
			B. Darai	Student
			S.H Darai	Agriculture
			M. R.Darai	Service
			P. B.Darai	Business
			M. Darai	Agriculture
			D. B.Darai	Service
			P. Adhikari	Agriculture
			D. M. Darai	Agriculture
			R. R.Darai	Service
			K. Darai	Agriculture
			P. Darai	Agriculture
			N. Darai	Agriculture
			K. Darai	Agriculture
3.	Mathillo Gyaga, manakamana VDC, ward no. 8, Gorkha district	06.03.2014	D. B. Thapa	Agriculture
			K. Thapa	Agriculture
			K.B. Thapa	Agriculture
			L. B. Thapa	Agriculture
			C. B. Thapa	Agriculture

No.	Location	Date	Name of the participant	Status of the participant
Marsyangdi – Kathmandu Transmission Line 220 kV				
			B. Thapa	Agriculture
			D. B. Thapa	Agriculture
			K. S. Thapa	Agriculture
			C. Thapa	Agriculture
			P. B. Thapa	Agriculture
			B. M. Thapa	Agriculture
			T. B. Thapa	Agriculture
			P. B.Thapa	Agriculture
			R. B. Thapa	Agriculture
			N. B.Thapa	Agriculture
			M. B. Thapa	Teacher
			Y. B.Thapa	Teacher
4.	Tawang, Jogimara VDC, ward no. 2, Chitawan District	07.03.2014	J. Chepang	Agriculture
			S. Chepang	Agriculture
			Sunita Chepang	Agriculture
			R. M. Chepang	Agriculture
			K. Chepang	Agriculture
			H. K. Chepang	Agriculture
			D. B. Chepang	Agriculture
			S. Chepang	Agriculture
			P. B. Chepang	Agriculture
			D. B. Chepang	Agriculture
			B. B. Chepang	Agriculture
5	Khor Bhanjyang, Jogimara VDC, ward no. 2, Dhading District	07.03.2014	R. N. Marahattha	Teacher
			B. Rijal	Teacher
			G. Aryal	Teacher
			A.R. Magar	Teacher
			J. K. Jha	Teacher
			R. Thapa	Teacher
			D. Rijal	Teacher
			A.Mishra	Teacher
			A.P. Adhikari	Teacher
			L. C. Dallakoti	Agriculture
			S. Magar	Agriculture
			K. P. Dallakati	Teacher
			R. P. Marahatta	Teacher
			K. K. Upreti	Service
6.	Kharka Sapanghati, Jogimara VDC ward no 1, Dhading District	08.03.2014	K.B. chepang	Agriculture

No.	Location	Date	Name of the participant	Status of the participant
Marsyangdi – Kathmandu Transmission Line 220 kV				
			D.K.Saudi	Agriculture
			H. Dallakoti	Agriculture
			G. Basnet	Business
			I.Rijal	Agriculture
			P. B. Basnet	Agriculture
			B.K.saudi	Agriculture
			D.D. Basnet	Agriculture
			K.K.Chettri	Agriculture
			R.Basnet	Agriculture
			B.K.Basnet	Agriculture
			S. Basnet	Student
7.	Naya Basti, Darechowk VDC, ward no. 3, Chitawan District	08.03.2014	B.Nepal	Agriculture
			P.P.Tripathi	Agriculture
			N.P.Paudel	Agriculture
			L.Tripathi	Housewife
			A.Nepal	Housewife
			S.B.Chepang	Agriculture
			J.B.Pariyar	Agriculture
			P.B.Chepang	Agriculture
8.	Jyamire Ghat, Ghyalchowk VDC ward no 5, Gorkha District	08.03.2014	G.Regmi	Agriculture
			B. Aryal	Agriculture
			T.Regmi	Agriculture
			D.REgmi	Agriculture
			R.Adhikari	Agriculture
			D.Regmi	Agriculture
			P.Regmi	Agriculture
			H.P.Regmi	Agriculture
			G.Regmi	Agriculture
			T.Regmi	Agriculture
			M.Regmi	Agriculture
			R.Regmi	Agriculture
			E.Duwadi	Agriculture
			R. Ghimire	Agriculture
			R. BK	Agriculture
			B.Regmi	Agriculture
			R.Khanal	Agriculture
9.	Dovantar, Kumpar VDC, ward no. 4, Dhading District	09.03.2014	S.magar	Driving
			R.Magar	student

No.	Location	Date	Name of the participant	Status of the participant
Marsyangdi – Kathmandu Transmission Line 220 kV				
			S.Shrestha	Driving
			D.Silwal	Agriculture
			S.Magar	Housewife
			F.Adhikari	Housewife
			M.Budhathoki	Housewife
			D.Thapaliya	Agriculture
			R. Thapaliya	Agriculture
			N.T.Magar	Agriculture
			C.B.Magar	Agriculture
			B.Magar	Driving
			B. Silwal	Housewife
			K. Darlami	Housewife
10	Misshtar, Kalleri VDC, ward no. 3, Dhading District	10.03.2014	M.Thakuri	Agriculture
			R.Thakuri	Agriculture
			B.Khatiwada	Agriculture
			T.K.Tamang	Agriculture
			S.M.BK	Agriculture
			M. Pariyar	Agriculture
			B.Malla	Agriculture
			N.Pariyar	Agriculture
			S.Thakuri	Agriculture
			G.Malla	Agriculture
			L.Thakuri	Agriculture
			H.Malla	Agriculture
			H.Magar	Agriculture
			S.T. Suryabansi	Agriculture
			A.Malla	Agriculture
			S. Khatiwada	Agriculture
			C.M.Pariyar	Agriculture
			S.Khatiwada	Agriculture
			B.Adhikari	Agriculture
			J.Khatiwada	Agriculture
11.	Beltar, Baireni VDC, ward no. 7, Dhading District	11.03.2014	B.Shrestha	Service
			S.Pulami	Agriculture
			d.Pulami	Student
			D.R.Chalise	Agriculture
			S.Lamichane	Agriculture
			S. Chalise	Agriculture
			Savitri Chalise	Agriculture
			H.K.Pant	Agriculture
			M.Shrestha	Student

No.	Location	Date	Name of the participant	Status of the participant
Marsyangdi – Kathmandu Transmission Line 220 kV				
			J. Pulami	Student
			S.Pulami	Agriculture
			P.Sapkota	Agriculture
			S.Pulami	Agriculture
			S.K.Tamang	Agriculture
			G.Sapkota	Agriculture
			N.Shrestha	Agriculture
			S.M.tamang	Agriculture
			K.Pulami	Agriculture
12	Gharti Tole, Kalleri VDC, ward no. 2, Dhading District	13/03/2014	A.N.Ojha	Agriculture
			T. Khatiwada	Agriculture
			R. Khatiwada	Agriculture
			K. Khatiwada	Agriculture
			T. Khatiwada	Agriculture
			M. Khatiwada	Agriculture
			B. Magar	Service
			K.P. Khatiwada	Agriculture
			B.P Khatiwada	Agriculture
			P. Shrestha	Agriculture
			C. L . Khatiwada	Agriculture
			T. P. Khatiwada	Agriculture
13	Thulogaun, Naubise VD, ward no. 8, Dhading District	14/03/2014	R.P. Subedi	Service- Army
			C. Upreti	Business
			G. Uprety	Agriculture
			A.Sharama	Social worker
			S. Subedi	Agriculture
			B.Subedi	Agriculture
			H. Rupakheti	Agriculture
			K. P. Budhathoki	Agriculture
14	Kaphal Chaur, Naubise VDC, Dhading District	15/03/2014	B. Tamanag	Business
			A.Tamanag	Agriculture
			S. Tamanag	Agriculture
			S. Tamanag	Skilled labour
			B.Tamanag	Skilled labour
			S.Tamanag	Agriculture
			P. Tamanag	Agriculture
			A.Tamanag	Agriculture
			R.Tamanag	Business
			M. Tamanag	Agriculture

No.	Location	Date	Name of the participant	Status of the participant
Marsyangdi – Kathmandu Transmission Line 220 kV				
			N. Tamanag	Agriculture
			T. Tamanag	Agriculture
			M. Tamanag	Agriculture
			F. Tamanag	Business
			M. Tamanag	Vegetable farming
			Maya Tamanag	Agriculture
			S. Tamanag	Agriculture
			B. Tamanag	Agriculture

Table A5.3: Summary Consultations on Marsyangdi Corridor

Issues Discussed	People's views and perceptions
General Perception about Project	Most of the communities were not aware of the proposed transmission line passing through their areas. Some communities have heard it but not sure what is going to happen in their communities in near future. Overall, it was through the research teams that they first heard about such electricity projects that would be implemented across their communities.
Support of local people for proposed project	Community response patterns were diverse. At one end, the communities expressed their fullest support in view of the projects' national importance. They believed that such projects would contribute to country's development such as expansion of industries and reduce the heavy import of fuel from third countries, increase the rate of rural electrification. They also hoped that the new projects will improve their electricity supply, reduce load shedding which is now more than 12 hours a day. They also requested the transmission line should go far from the settlement. At the other end, some communities were concerned about the loss of crops etc and the safety issues during construction. Communities who expressed willingness to support provided the project expressed that there should be no adverse impact due to the project on their houses, cultivations, livelihoods and safety; expressed willingness to support provided the project adequately compensates any losses in cash
Critical issue and concern by the local people for the project	Most of them in the opinion that if suitable environment is made for the resuse of existing productive land, there will be no problem. Again they should be compensated reasonable for their loss of assets. Some of the communities raised issues/concerns that were highlighted. They included (a) fear of losing or causing damages to their residences, cultivations, and livelihoods. (b) fear of decreasing the land values when electricity lines run over their land or polls/towers installed in the middle of a land; (c) fear of not receiving reasonable compensation for the affected assets like trees, house, (d) some people believed that living in areas close to electricity lines, towers and polls would increase the threats of lightening; (e) a few communities believed that living closer to electricity lines would have negative impact on their health. Therefore, they expressed all these concerned should be taken in to consideration by the engineering while finalizing the design.
Criteria liked to see during project design, operation stage and construction	The projects should avoid/minimize harm to residences, plantations, cultivations, other forms of livelihoods, religious and other places of community importance such as schools play grounds etc. Line routes should avoid running over houses. Necessary precautions must be taken to ensure safety of people during project construction.

Issues Discussed	People's views and perceptions
Employment potential in the project	Majority of the rural communities expressed that the project will bring lot of employment opportunities to local people. Some of the communities request that they should be involved not only in unskilled labour but also in the administrative work along with the supervisors work. Though the skilled labour are unavailable in the communities, they should be provided training during project construction. The communities preferred if construction work is carried out during off-seasons [of their agricultural activities] so that they would be able to find alternate income by providing their labour to project construction work. They complained that the construction work is generally handed over to contractors who would bring their own labour force from outside. Thus, they would not require any village labour. They also hoped that they would be able to sell the foods, or run small shops like tea, grocery, fast food for the workers during construction.
Ethnic Minorities	A majority of the communities covered in consultations composed of different ethnic group i.e. non –indigenous people like Brahmin/Chettri, indigenous people like Magar, Gurung, Shrestha, Bhujel, Darai, Lama, Tamang. However, there were very few ethnic minority people like Biswakarma, Damai, Pariyar participated in the discussion.
No of shops/commercial establishments	None of the communities had any large scale business enterprises. Almost all the communities had retail grocery, tea, alcohol shops whose numbers ranged between 5-30. Among the commercial enterprises were rice mills, flour grinding mills, furniture/saw mills, grill mills. But they were found only in a few communities.
Number of industrial units	No such industrial units found in the communities.
Socio economic standing: land use, cropping pattern	In the hills and upper hills, maize, millet, potato cultivation was the major source of livelihood of the families. However, paddy cultivation was restricted to a single season of the year only in rainy season. Most of the families have some animal husbandry like goats, sheep, pigs poultry. But few households have the cattle, buffaloes kept in the house for making the compost manure and ploughing into the field. The extents of land cultivated by the farmers ranged between 5 ropani – 50 ropani (0.25 ha- 3 ha). Incomes of the communities were supplemented by remittances from outside whose family members worked mostly in the gulf countries and India in different office, factories, construction work etc. Some family members have been employed in the government and private sector too. The settlements in the rural areas are very scattered and some cluster settlement is found in some places. Almost 1 male members of the families were temporarily migrated to other countries for the work. The number of female migrant is very minimal.

Issues Discussed	People's views and perceptions
Sources of irrigation	Most of the agricultural activities in the communities were rain fed. Or else, they were dependent on the small irrigation canal carried out from the small stream and river like Bhaise khola, Pangram khola, Bimire khola, Gobling khola, Marsyangdi. Some families had the lift irrigation facilities. They pump the water from the river and irrigate their land. So in most cases single crop is made in one year. In Majhigaun, they have just constructed irrigation canal and bring the water from *Tardi Khola*.
Access to Forest Land and Use	The government of Nepal has the policy of handing over the government forest to Forest users groups formed under the Community Forestry programme. So in most of the places, the forest is managed by the community. None of the communities consulted had extensive dependence on forest resources. Several communities were located far away from forest reserves. The committee can decide to collect the firewood and the fodder for their household consumption. However, they have to plant new trees manage the forest under their jurisdiction.
Current rates for agricultural land	Prices of agricultural land were subject to variation depending on several criteria e.g. (a) its use - whether the land is used for paddy cultivation or highland crop cultivation; (b) availability of irrigation facilities; and (c) location – whether the land is situated closer to access roads or in the interior. In adjoining the road the land value ranges from NRs. 20,000,000 to Rs. 80,00,000 for 1 Ropani (0.051 ha). Along the road, due to scarcity of land even the land price is not fixed, the owner asked whatever he like. But interior the road side the price ranges from NRs. 200,000 to 800,000 per ropani((0.051 ha).
Sources of power supply	Majority of the communities were dependent on government sources for electricity supply. However, in few settlements like Chandisthan , Dharapani and Udipur VDCs, they have community managed power supply.
Sources of electricity	Government grid is the only source of electricity for the communities.
Average amount of electricity used by per household per day	The quantum of electricity used by a household varied. Households that used electricity only for the purpose of lighting and sometimes for operating a TV as observed in several villages consumed 1-3 units per day. Households that used electricity for lighting as well as for operating electrical appliances such as TVs, refrigerators, irons, and water motors [which were the appliances commonly used] consumed 3-5 units per day.
Unit Rate	The unit rate varied along with the number of units consumed [according to variable standard rates set by NEA]. Households that consumed Up to 20 Unit of 5 ampere per month had to pay Rs.80/- per unit whereas households that consumed more than 20 units had to pay above Rs.6/- to Rs.8/60- per unit up to 250 units per month.

Issues Discussed	People's views and perceptions
Average total monthly expenditure per household on grid electricity	The average monthly bill varied between Rs. 120/- to Rs. 300/- for low users whereas for other medium users it ranged between Rs.300/-to Rs.600/- per month.
Other non grid electricity to use in your village and expenditure	None of the communities consulted reported having used non-grid electricity sources in their villages.
Source of drinking water	Some piped water/tap supply found in some communities. They bring the water through pipe from the water source in the hills. Otherwise, majority of the families in the communities depend on river and stream for the drinking water supply.
Shortage of water	Families did not experience a major shortage of water as there were several sources to collect water such as rivers, streams, etc. in periods of water scarcity. However, in the dry zone, people experienced difficulties in accessing water for both cultivations and domestic use particularly during dry season. Some had to travel 1-2 Km to bring water for their domestic use.
Negative impact on food grain, availability /land use	In general, people did not see any adverse impact on food/grain availability. However, they cautioned that if electricity polls/towers are installed in the paddy fields or other cultivable land, it would reduce the cultivable area of the farmers.
Will project cause landslides or soil erosion	They are not aware of the landslides or soil erosion due to the construction of transmission line. If it is , it should be controlled properly.
Will project cause widespread imbalance by cutting fruit and commercial trees in the locality	People were unable to give a precise answer to this question as they did not know the exact extent to which the trees would be cut-down. The majority did not foresee such an imbalance. However, they cautioned that if the project cuts down valuable commercial trees e.g. fruit trees, timber such as *Sal trees* and mangoes in significant numbers it would drastically affect the livelihoods and incomes of families who are dependent on those trees.
Will project cause health and safety issues	Some communities expressed their fears of increasing risks to their lives from lightening when they have to live closer to electricity lines and towers. Some others believed that living closer to electricity lines can harm the health condition. But the majority did not foresee any health or safety issues. Installing towers in the middle of settlements would raise safety issues particularly for children. And communities suggested that such towers should be fenced around.
Resettlement and land acquisition	It is only in the case of constructing grid sub stations or distribution gantries that land may have to be acquired or purchased in the open market. NEA has identified government owned barren land for a majority of the proposed grid stations and gantries. Therefore, it will not

Issues Discussed	People's views and perceptions
	cause any loss of private properties or population displacements. In the case of private properties identified for the construction of grid stations and gantries, all the land owners are 'willing sellers'. Communities consulted could recall the land acquisitions for previous Middle Marsyangdi Hydro Power Project. It varied based on the location of land, up land low land. They have received NRs 25, 000 to Rs.800, 000 per ropani. In a few places they could recollect NEA paying compensation to families who lost valuable trees or plots of paddy land where towers were installed. They prefer market rate for valuation of lost assets to be compensated.
Protected areas	No protected areas were observed within the communities consulted.
Health status	In each VDC they have access of a sub health within half to one hour of walk from their residence. The communities consulted were satisfied on the available health facilities and the services provided. They all had easy access to both government and private medical services. But for the chronic and more acute disease they have to go either to Pokhara or Bharatpur or Kathmandu for the treatment. The district hospitals are not so much equipped for the treatment of chronic and more problematic diseases. However, both medical staff and drugs were adequately available in the government hospitals. In contrary, some communities complained of poor health services, lack of drugs and doctors. Private medical centres are very far away from their villages. Though private medical centres too were available within easy reach, they did not go to such places because they could not pay for those services
Will project setting change migration pattern of animals	None of the communities were conscious of the presence of any migrant birds or animals in their localities and therefore did not foresee any impacts on such animals, birds or their habitats.
Poverty Level	A significant proportion (approximately 40%-60%) of the population in the communities consulted reported as having an *average* socio-economic status. This means that they were able to have three meals a day. The proportion of *poor* families in the communities accounted for 10-30 percent and they represented families who did not have a stable source of income and were largely dependent on casual labour work. The numbers of *very poor* families in the communities were negligible in most communities and constituted less than 5%.
Educational status	The literacy rate in general was high in all the communities. The younger generation in the rural communities had a higher educational level compared to their elders. The school drop-out rate was extremely low and most of the children pursued continuous education at least upto class 10. Economic difficulties in the families

Issues Discussed	People's views and perceptions
	were the major reasons for some children to discontinue their education. Communities were also satisfied with the services provided by government schools. Education of children had been adversely affected during *Maoist* insurgency in Nepal from 1996-2006 (due to war and displacement).
Employment status	Majority of the people (more than 60 %) depend an agriculture in rural hill areas. However, some of them have been engaged in development projects like Middle Marsyangdi Hydro power, and hydro power projects under construction like Upper Marsyangdi and Khudi under private sectors, bridges, culvert, roads or in local NGOs, a few school teachers. But their percentage is very minimal. Some of them have engaged in their own small shops like retail grocery, tea, food, fruit sale shops. Most of the young generation had gone gulf countries in search of employment. So the major sources of earning was remittance from their family members working outside the country. On the average, the unemployment and under employment ranges from 10-15 percent.
Migration pattern	Outward migration is comparatively high in rural areas than in urban areas. Most of the young generation especially the boys have migrated for foreign employment especially in the gulf countries in search of employment.
Type of compensation expected	Adequate cash compensation was expected for any losses to their houses, properties, cultivations and livelihoods. Some communities asked for replacement of land and [if lands and houses were acquired] within the same geographical area in addition to cash compensation. When compensating for loss of cultivations and trees, they requested that prospective income losses from such cultivations and trees should be considered. Some families did not have any legitimate rights (legal entitlement certificate for land)for the land they lived and cultivated.
Perceived benefits from project	Most communities were of the view that the proposed projects would benefit the country as a whole but they would not accrue much direct benefits to their individual communities. They thought that projects would contribute to minimize the prevailing energy crisis, load shedding in the country; increase the rate of rural electrification and provide energy for the industrial sector. At micro level, they hoped that projects would provide electricity to non-electrified households in their communities and offer labour work during project construction.
Perceived loss	It is temporary in nature due to loss of crops and trees and can be compensated by NEA.
Other organizations active in the area	Not many active community based organizations or NGOs were found in the communities consulted. In some communities CBO/ NGO like cooperatives, credit and savings, youth organization were functioning in the rural areas. They are assisting in water supply, income

Issues Discussed	People's views and perceptions
	generating activities and providing technical support to the credit and saving groups and community welfare. Interventions of external NGOs were almost non-existent.
Village Committee	Since the dissolution of the local bodies (VDC, DDC) in 2002, these village development committees are functioning without elected people's leadership. VDCs, local bodies are the lowest units of the government's service delivery mechanism. The local bodies is now functioning merely by the government appointed employee who were mostly absence in the office and presence in the district headquarter. But a number of communities mentioned that if their communities faced a critical issue, the entire village will get together including the representation from different local political parties and make a decision on how to address the problem. Several people mentioned that it was the local politicians and the local administrators who generally make decisions on community issues and gear the development programs and activities.
Usefulness of consultation	All the communities appreciated the consultation and sharing information on prospective development projects that would go through their villages. Communities noted that such consultations were rather rare and people would know about a project only when the foundation stone is laid for it. Sharing information is important so that communities can support the implementing agencies to minimize adverse effects of the projects and increase the implementation efficiency.

Table A5.4: LIST OF PARTICIPANTS / PUBLIC CONSULTATIONS
Marysangdi Corrdidor

No	Location	Date	Name of the participant	Status of the participant
Marsyangdi Corridor Transmission Line 220 kV				
1.	Taal, Dharapani VDC, ward no 1, Manang District	2/13/2014	B. B. Gurung	Hotel
			M. R. Gurung	Social Serivces
			K. Gurung	Hotel
			T. Lama	Hotel
			P. B. Gurung	Hotel
			J. B. Tamang	Teacher
			R. C. Gurung	Hotel
			K. Gurung	Services
			P. Lama	Agriculture
			T. B. Gurung	Agriculture

No	Location	Date	Name of the participant	Status of the participant
Marsyangdi Corridor Transmission Line 220 kV				
			D.	Agriculture
			M. B. Gurung	Agriculture
			G. P. Gurung	Teacher
			S. Gurung	Resturant
			B. Gurung	Services
			D. J. Gurung	Youth
			Y. B. Gurung	Youth
			B. Gurung	
			B. B. Gurung	
			C. Gurung	
			S. J. Ghale	
			D. Gurung	
			R. Kumari	
2	Khudi chhabim, Khudi VDC, ward no. 1 Lamjung District	2/15/2013	S. B. Tamang	Agriculture
			D. B. Tamang	Agriculture
			P. Lama	Other
			K. Lama	Other
			N. Lama	Other
			P. Lama	Other
			S. Tamang	Agriculture
			S. Tamang	Agriculture
			S. Tamang	Agriculture
			D. Tamang	Agriculture
			R. Mijar	Agriculture
			R. Lama	Student
			B. Lama	Student
3	Talphat, gaunsahar VDC, ward no 6, Lamjung District	2/17/2014	B. Gurung	Agriculture
			N. Gurung	Labour
			S. Gurung	Student
			S. J. Gurung	Labour
			M. S. Gurung	Services
			B. B. Kadel	Agriculture
			K. R. Dital	Agriculture
			M. Gurung	Agriculture
			H. B. Acharya	Agriculture
			O. B. Khadka	Agriculture
			C. S. Dital	Agriculture
			B. B. Dital	Agriculture
			S. B. Dital	Agriculture
			R. Dital	Agriculture

No	Location	Date	Name of the participant	Status of the participant
Marsyangdi Corridor Transmission Line 220 kV				
			B. Neoupani	Agriculture
			S. Dital	Agriculture
			A. Thapa	Student
4	Okhle Phat, Besisahar VDC, ward no. 1, Lamjung District	2/18/2014	N. B. Gurung	Business
			S. B. Bhujel	Agriculture
			G. B. Gurung	Labour
			B. B. Ghale	Agriculture
			H. K. Shrestha	Agriculture
			R. Tamang	Labour
			R. B. Gurung	Hotel
			G. Gurung	Hotel
			S. Thapa	Student
			K. Shrestha	Student
5	Udipur, Udipur VDC, ward no. 4, Lamjung District	2/20/2014	B. Shrestha	Business
			R. B. Bohara	Agriculture
			R. K. Panna	Agriculture
			P. Joshi	Agriculture
			R. C. Panta	Agriculture
			M. B. Shakya	Business
			G. D. Panta	Business
			H. Budhathoki	Business
			S. H. Joshi	Business
			H. Adhikari	Teacher
			C. B. Khaswe	Services
			G. B. Panta	Agriculture
6	Baluti Bisaune, Chandisthan VDC, ward no. 8, Lamjung District	2/21/2014	K. B. Rimal	Agriculture
			A. Rimal	Student
			A. Rimal	Housewife
			D. Rimal	Housewife
			G. Bi.Ka	Business
			N. Rimal	Student
			S. Shrestha	Business
			B. K. Rimal	Agriculture
			J. Rimal	Housewife
			B. Shrestha	Business
7	Dharapani, Bhotewodar VDC, ward no. 8, Lamjung District	2/21/2014	K. K. Khanal	Teacher
			M. Khanal	Teacher

No	Location	Date	Name of the participant	Status of the participant
Marsyangdi Corridor Transmission Line 220 kV				
			M. Khanal	Business
			K. N. Sapkota	Social Serivces
			B. K. Adhikari	Social Serivces
			G. P. Khanal	Social Serivces
			R. K. Adhikari	Teacher
			R. K. Adhikari	Agriculture
			P. Khanal	Agriculture
			R. Khanal	Agriculture
8	Majhi Gaun, Tarughat VDC, ward no 1, Lamjung District	2/26/2014	K. B. Gurung	Teacher
			S. B. Gurung	Services
			R. Bista	Student
			L. B. Gurung	Agriculture
			K. Giri	Agriculture
			S. R. Lamichane	Teacher
			B. R. Lamichane	Teacher
			R. C. Lamichane	Services
			S. L. Shrestha	Teacher
			K. Nepali	Student
			N. Khatri	Student
			S. Bhujel	Student
			S. Giri	Agriculture
			R. B. Nepali	Agriculture
			B. Bista	Agriculture
			R. Gurung	Agriculture
			P. Giri	Agriculture
			S. Gurung	Agriculture
9	Tarkughat Bazar, Tarkughat VDC, ward no 9, Lamjung District	2/26/2014	K. K. Shrestha	Agriculture
			M. R. Shrestha	Business
			T. K. Shrestha	Agriculture
			H. K. Shrestha	Agriculture
			G. P. Shrestha	Agriculture
			T. R. Shrestha	Agriculture
			M. Shrestha	Agriculture
			R. Shrestha	Agriculture
			P. Gurung	Agriculture
			P. Bhujel	Agriculture
			S. Miya	Agriculture
			R. K. Chetri	Agriculture
			B. Shrestha	Agriculture
			S. Shrestha	Services

No	Location	Date	Name of the participant	Status of the participant
Marsyangdi Corridor Transmission Line 220 kV				
			C. N. Shrestha	Agriculture
10	Pachbhaichoutara, Dhamilikuwa VDC, ward no. 3, Lamjung District	2/27/2014	B. L. Shrestha	Business
			N. S. Gurung	Business
			A. Shrestha	Business
			A. M. Tamang	Labour
			S. Gurung	Business
			B. Adhikari	Agriculture
			S. Malla	Business
			S. Pariyar	Business
			G. Chiluwal	Agriculture
11	Nayabazar ground, Palungtar, Ward no. 9, Gorkha District	2/27/2014	P. B. Adhikari	Agriculture
			C. K. Shrestha	Agriculture
			C. K. Shrestha	Business
			R. B. Shrestha	Business
			A. B. Aale	Business
			T. Miya	Business
			H. B. Tamang	Agriculture
			R. Shrestha	Business
			K. B. Tamang	Agriculture
			T. B. Pun	Agriculture
			K. P. Khanal	Business
			H. K. Shrestha	Business
			L. B. Tamang	Business
			C. B. Shrestha	Business
			M. B. Tamang	Agriculture
			R. L. Gurung	
			H. Aale	
			G. Thapa	
			R. Gurung	
			T. B. Nepali	Business
12	Sauwatar, Gaikhur VDC, ward no 1, Gorkha District	2/28/2014	K. Barkori	Health
			S. Pandey	Teacher
			L. Bahadur	Agriculture
			G. Achhami	Agriculture
			P. B. Gharti	Agriculture
				Agriculture
			A. B. Kafle	Agriculture
			N. B. Subedi	Agriculture
			I. B. Adikari	Agriculture

No	Location	Date	Name of the participant	Status of the participant
Marsyangdi Corridor Transmission Line 220 kV				
13	Gopling, deurali VDC, ward no. 3, Gorkha District	3/1/2014	R. B. Khadka	Services
			H. B. Karki	Agriculture
			R. B. Khatri	Agriculture
			D. Mahat	Services
			R. B. Adikari	Services
			S. Panta	Agriculture
			K. Kadaka	Agriculture
			B. B. Rai	Agriculture
			K. Bote	Agriculture
			M. Darou	Agriculture
			B. Khadka	Student
			J. B. Khadka	Services
			K. Thapa	
			T. Bahadur	Agriculture
			P. B. Khadka	Agriculture
			N. B. Khatri	Agriculture
			S. Adikari	Agriculture
14	Markichowk, Aabukhaireni VDC, ward no 3, Tanahu District	3/1/2014	N. B. Gurung	Agriculture
			U. B. Magar	Agriculture
			K. B. Gurung	Agriculture
			J. Shrestha	Agriculture
			D. B. Panta	Agriculture
			K. Sauad	Agriculture
			M. B. Khitare	Agriculture
			S. Thapa	Agriculture
			M. B. Gurung	Agriculture
			D. B. Gurung	Agriculture
			B. Namjali	Agriculture
			B. Gurung	Agriculture
			C. Shrestha	Agriculture
			B. B. Gurung	Agriculture
			M. N. Nakahi	Agriculture
			E. Bahadur	Agriculture
			S. B. Gurung	Agriculture
			B. B. Gurung	Agriculture
			B. Panta	Agriculture
			A. Gurung	Agriculture
			M. R. Gurung	Business
			R. K. Gurung	Student
			M. B. Gurung	Agriculture

No	Location	Date	Name of the participant	Status of the participant
Marsyangdi Corridor Transmission Line 220 kV				
			R. D. Nahaki	Agriculture
			P. Gurung	Agriculture
			M. K. Panta	Agriculture
			M. Panta	Agriculture
			K. K. Panta	Agriculture
			K. Kadel	Agriculture
			P. Panta	Agriculture
			S. K. Nahaki	Agriculture
			D. M. Gurung	Business
			A. Gurung	Agriculture
			L. Gurung	Business
	Dhangri, Khudi VDC, ward no 3,	3/14/2014	M. B. Gurung	Agriculture
	Lamjung District		C. S. Gurung	Agriculture
			S. Gurung	Agriculture
			T. B. Gurung	Teacher
			D. S. Gurung	Agriculture
			K. Gurung	Agriculture
			B. Gurung	Agriculture
			M. B. Gurung	Agriculture
			C. B. Gurung	Agriculture
			N. B. Gurung	Agriculture
			S. B. Gurung	Agriculture
			S. B. Gurung	Agriculture
			L. B. Gurung	Agriculture
			B. K. Gurung	Agriculture
			D. Gurung	Agriculture
			A. Gurung	Agriculture
			B. B. Gurung	Agriculture
			S. B. Gurung	Agriculture
			D. B. Gurung	Agriculture
			K. S. Gurung	Agriculture
			D. P. Gurung	Agriculture
			S. Gurung	Agriculture
			F. B. Gurung	Agriculture
			P. B. Gurung	Agriculture
			K. B. Gurung	Agriculture
			S. J. Gurung	Agriculture
			J. K. Gurung	Agriculture
			C. K. Gurung	Agriculture
			G. M. Gurung	Agriculture
			B. M. Gurung	Agriculture
			M. Gurung	Agriculture

No	Location	Date	Name of the participant	Status of the participant
Marsyangdi Corridor Transmission Line 220 kV				
			B. Gurung	Agriculture

Table A5.5: Summary Findings on Public Consultations
Kaligandaki Corridor

Issues Discussed	People's views and perceptions
General Perception about Project	Most of the communities were not aware of the proposed transmission line passing through their areas. Some communities have heard it but not sure what is going to happen in their communities in near future. However, they were positive and supportive towards the proposed project.
Support of local people for proposed project	Since the project has been considered as one of the government priority sector and need of the country, they expressed their full support during implementation. They believed that such projects would contribute to country's development such as expansion of industries and reduce the heavy import of fuel from third countries, increase the rate of rural electrification. They also hoped that the new projects will improve their electricity supply, reduce load shedding which is now more than 12 hours a day. They also requested the transmission line should go far from the settlement. At the other end, some communities were concerned about the loss of crops etc and the safety issues during construction. Communities who expressed willingness to support provided the project expressed that there should be no adverse impact due to the project on their houses, cultivations, livelihoods and safety; expressed willingness to support provided the project adequately compensates any losses in cash
Critical issue and concern by the local people for the project	Most of them in the opinion that if suitable environment is made for the reuse of existing productive land, there will be no problem. They also wanted to know the exact transmission line passing through. Some of the communities raised issues/concerns that were highlighted. They included (a) fear of losing or causing damages to their residences, cultivations, and livelihoods. (b) fear of decreasing the land values when electricity lines run over their land or polls/towers installed in the middle of a land; (c) fear of not receiving reasonable compensation for the affected assets like trees, house, (d) some people believed that living in areas close to electricity lines, towers and polls would increase the threats of lightening; (e) a few communities believed that living closer to electricity lines would have negative impact on their health. Therefore, they expressed all these concerned should be taken in to consideration by the engineering team while finalizing the design.
Criteria liked to see during project design, operation stage and construction	The projects should avoid/minimize harm to residences, plantations, cultivations, other forms of livelihoods, religious and other places of community importance such as schools play grounds, community gathering places etc. Line routes should avoid running over houses. Necessary precautions must be taken to ensure safety of people during project construction.
Employment potential in the project	Majority of the rural communities hoped that the project will bring lot of employment opportunities to local people. Some of the communities request that they should be involved not only in unskilled labour job but also in the administrative work along with the supervisors work. Though the skilled labour are mostly

Issues Discussed	People's views and perceptions
	unavailable in the communities, they should be provided training during project construction. They complained that the construction work is generally handed over to contractors who would bring their own labour force from outside. They hoped that they would be able to sell the foods, or run small shops like tea, grocery, fast food for the workers during construction.
Ethnic Minorities	A majority of the communities covered in consultations composed of different ethnic group i.e. non –indigenous people like Brahmin/Chettri, indigenous people like Magar, Gurung, Shrestha. However, there were also representation in the discussion of disadvantaged group like Biswakarma, Damai, Pariyar.
No of shops/commercial establishments	None of the communities had any large scale business enterprises. Almost all the communities had hotel, retail grocery, tea, whose numbers ranged between 5 - 60. Among the commercial enterprises were small factory based on the agricultural products (*Lapsi*) rice mills, furniture, flour grinding mills. Shops were found in almost all communities.
Number of industrial units	No such industrial units found in the communities.
Socio economic standing: land use, cropping pattern	In the hills and upper hills, maize, millet, potato cultivation was the major source of livelihood of the families. In the plain area, paddy, wheat, mustard seed, lentils, beans was the main source of livelihood of the families. Most of the families have some animal husbandry like goats, sheep, pigs poultry in the hills. The extents of land cultivated by the farmers ranged between 5 ropani – 30 ropani (0.25 ha- 1.5 ha). However, in the city and core areas it ranged between 1 ropani to 5 ropani. Incomes of the communities were supplemented by remittances from outside whose family members worked mostly in the gulf countries, Europe and India in different office, factories, construction sector etc. Some family members have been employed in the government and private sector too. Almost 1 male member from one household was temporarily migrated to other countries for the work. The number of female migrant is very minimal.
Sources of irrigation	Most of the agricultural activities in the communities were rain fed. In some communities, small irrigation canal carried out from the river and stream like Bachha khola, Ghandsingh khola, Malyangdi khola, Lamahe khola, Laksti khola, Pungdi khola, Ghatte khola, Tinau khola. So in most cases two crops is made in one year.
Access to Forest Land and Use	The government of Nepal has the policy of handing over the government forest to Forest users groups formed under the Community Forestry programme. On the transmission line corridor the following community managed forest were reported: Thulo Salleri, Laxminarayan,Nepane, Nausiwala, Upallo pakho, tallochaur, Mudikuwa, Samakheriya, Majhi khatto, Akrate Bhuebhara, Khoriya, Khjare Salyan, Ghopte Salghare, Dhairane, Dhorakhoria Chaurmuni,Khabar, Dapsechaur, Kalika, Hattikot, Ukhoure Hariyali, Milan Samudayik, Ganga Zamuna Community Forests. So in most of the places, the forest is managed by the community. None of the communities

Issues Discussed	People's views and perceptions
	consulted had extensive dependence on forest resources. Several communities were located far away from forest reserves. The committee can decide to collect the wastage firewood and the fodder for their household consumption. However, they have to plant new trees and manage the forest under their jurisdiction.
Current rates for agricultural land	Prices of agricultural land were subject to its use and its location (a) its use - whether the land is used for paddy cultivation or highland crop cultivation; (b) availability of irrigation facilities; and (c) location – whether the land is situated closer to roads or in the interior. In adjoining the road the land value ranges from NRs. 2,000,000 to Rs. 10,00,000 for 1 Ropani (0.051 ha) in the hills. Along the road, in plain area, price of land is not fixed, the owner asked whatever he like. But interior the road side the price ranges from NRs. 20,000 to 500,000 per ropani((0.051 ha).
Sources of power supply	Majority of the communities were dependent on government sources for electricity supply. However, in few settlements like in Koldanada and Dovan VDC, micro hydro power which was managed by the community. In other places , they have to depend on the Government, NEA. In one settlement, Mudibas, Devdaha VDC, Rupandehi district, there was no power supply.
Sources of electricity	Government grid and few settlement have the community managed micro hydro power.
Average amount of electricity used by per household per day	The quantum of electricity used by a household varied. Households that used electricity only for the purpose of lighting, operating a TV and other as observed in several villages consumed 1-3 units per day. Households that used electricity for lighting as well as for operating electrical appliances such as TVs, refrigerators, irons, and water motors [which were the appliances commonly used] consumed 4-7 units per day.
Unit Rate	The unit rate varied along with the number of units consumed [according to variable standard rates set by NEA]. Households that consumed Up to 20 Unit of 5 ampere per month had to pay Rs.80/- per unit whereas households that consumed more than 20 units had to pay above Rs.6/- to Rs.8/60- per unit up to 250 units per month.
Average total monthly expenditure per household on grid electricity	The average monthly bill varied between Rs. 80/- to Rs. 150/- for low users whereas for other medium users it ranged between Rs.300/-to Rs.600/- per month.
Other non grid electricity to use in your village and expenditure	None of the communities consulted reported having used non-grid electricity sources in their villages.
Source of drinking water	Piped water/tap supply found in some communities. They bring the water through pipe from the water source in the hills. Otherwise, majority of the families in the hills depend on the river and stream while the tarai , (low land) people depend on the ground water from hand tube well, shallow tube well. In one settlement Deurali, Uram VDC, Parbat district, community used to rain water harvesting for the drinking and other

Issues Discussed	People's views and perceptions
	purposes.
Shortage of water	Families did not experience a major shortage of water as there were several sources to collect water such as rivers, streams, ponds, ground water source etc. in periods of water scarcity. However, in the dry zone, people experienced difficulties in accessing water for both cultivations and domestic use in the hills. Some had to travel 1-2 Km to bring water for their domestic use. But not somuch water shortage in the tarai area.
Negative impact on food grain, availability /land use	In general, people did not see any adverse impact on food/grain availability. However, they cautioned that if electricity polls/towers are installed in the paddy fields or other cultivable land, it would reduce the cultivable area of the farmers.
Will project cause landslides or soil erosion	They were not aware of the landslides or soil erosion due to the construction of transmission line. If it is, it should be controlled properly.
Will project cause widespread imbalance by cutting fruit and commercial trees in the locality	People were unable to give a precise answer to this question as they did not know the exact extent to which the trees would be cut-down. The majority did not foresee such an imbalance. However, they cautioned that if the project cuts down valuable commercial trees e.g. fruit trees, timber such as *Sal trees* and mangoes in significant numbers it would drastically affect the livelihoods and incomes of families who are dependent on those trees.
Will project cause health and safety issues	Very few communities expressed their fears of increasing risks to their lives from lightening when they have to live closer to electricity lines and towers. Some others believed that living closer to electricity lines can harm the health condition. But the majority did not foresee any health or safety issues. Installing towers in the middle of settlements would raise safety issues particularly for children. And communities suggested that such towers should be fenced around.
Resettlement and land acquisition	It is only in the case of constructing grid sub stations or distribution gantries that land may have to be acquired or purchased in the open market. NEA has identified government owned barren land for a majority of the proposed grid stations and gantries. Therefore, it will not cause any loss of private properties or population displacements. In the case of private properties identified for the construction of grid stations and gantries, all the land owners are 'willing sellers'. No one in the communities consulted could recall the land acquisitions for previous projects. However, if they lose any assets for the project, they prefer market rate for the compensation.
Protected areas	No protected areas were observed within the communities consulted.
Health status	Major VDCs have access of a sub health post within half to two hours of walk from their residence. But some communities had to travel 5 -8 km to reach the health post. Some communities consulted were not satisfied on the available health facilities and the services provided. The district hospitals are not so much equipped for the treatment of chronic and more problematic diseases. However, both medical staff and drugs were adequately available in the government hospitals. In

Issues Discussed	People's views and perceptions
	contrary, some communities complained of poor health services, lack of drugs and doctors. Private medical centres are very far away from their villages. Though private medical centres too were available within easy reach, they did not go to such places because they could not pay for those services
Will project setting change migration pattern of animals	None of the communities were conscious of the presence of any migrant birds or animals in their localities and therefore did not foresee any impacts on such animals, birds or their habitats.
Poverty Level	A significant proportion (approximately 40%-50%) of the population in the communities consulted reported as having an *average* socio-economic status. This means that they were able to have three meals a day. The proportion of *poor* families in the communities accounted for 20-40 percent and they represented families who did not have a stable source of income and were largely dependent on casual labour work. The numbers of *very poor* families in the communities constituted less than 10%.
Educational status	The literacy rate in general was high in all the communities. The literacy rate in the surveyed communities ranges between 80 to 90 %.The school drop-out rate was extremely low and most of the children pursued continuous education at least up to class 10. Economic difficulties in the families were the major reasons for some children to discontinue their education. Communities were also satisfied with the services provided by government schools. Education of children had been adversely affected during *Maoist* insurgency in Nepal from 1996-2006 (due to war and displacement).
Employment status	Majority of the people (more than 60 %) depend an agriculture in rural hill areas. However, some of them have been engaged in development projects like Mistri Hydro power, Modi hydro power projects under construction, bridges, culvert, roads or in local NGOs, a few school teachers. But their percentage is very minimal. Some of them have engaged in their own small shops like retail grocery, tea, hotels, food, Most of the young generation had gone gulf countries in search of employment. So the major sources of earning was remittance from their family members working outside the country. On the average, the unemployment and under employment ranges from 10-15 percent.
Migration pattern	Outward migration is comparatively high in rural areas than in urban areas. Most of the young generation especially the boys have migrated for foreign employment especially in the gulf countries in search of employment.
Type of compensation expected	Adequate cash compensation was expected for any losses to their houses, properties, cultivations and livelihoods. Some communities asked for replacement of land and [if lands and houses were acquired] within the same geographical area in addition to cash compensation. When compensating for loss of cultivations and trees, they requested that prospective income losses from such cultivations and trees should be considered. Some families did not have any legitimate rights (legal entitlement certificate for land) for the land they lived and cultivated. But they should be compensated properly.

Issues Discussed	People's views and perceptions
Perceived benefits from project	Most communities were of the view that the proposed projects would benefit the country as a whole but they would not accrue much direct benefits to their individual communities. They thought that projects would contribute to minimize the prevailing energy crisis, load shedding in the country; increase the rate of rural electrification and provide energy for the industrial sector. At micro level, they hoped that projects would provide electricity to non-electrified households in their communities and offer labour work during project construction.
Perceived loss	It is temporary in nature due to loss of crops and trees and can be compensated by NEA.
Other organizations active in the area	No such active community based organizations or NGOs were found in the communities consulted. In some communities CBO/ NGO like Rural Aware Forum, Dairy cooperatives, *Hariyali Krishi Samuha, Gramin Bikas Bank*, Nepal Red cross were functioning in the rural areas. But in many settlements, they have saving and credit cooperatives, mothers groups, youth club. They are assisting in income generating activities and providing technical support to the credit and saving groups and community welfare. Interventions of external NGOs were almost non-existent.
Village Committee	Since the dissolution of the local bodies (VDC, DDC) in 2002, these village development committees are functioning without elected people's leadership. VDCs, local bodies are the lowest units of the government's service delivery mechanism. The local bodies is now functioning merely by the government appointed employee who were mostly absence in the office and presence in the district headquarter. But a number of communities mentioned that if their communities faced a critical issue, the entire village will get together including the representation from different local political parties and make a decision on how to address the problem. Several people mentioned that it was the local politicians and the local administrators who generally make decisions on community issues and gear the development programs and activities.
Usefulness of consultation	All the communities appreciated the consultation and sharing information on prospective development projects that would go through their villages. Communities noted that such consultations were rather rare and people would know about a project only when the foundation stone is laid for it. Sharing information is important so that communities can support the implementing agencies to minimize adverse effects of the projects and increase the implementation efficiency.

Table A5.6: LIST OF PARTICIPANTS / PUBLIC CONSULTATIONS
Kali Gandaki Corridor

No.	Location	Date	Name of the participant	Status of the participant
Kaligandaki Corridor Transmission Line			**220 kV**	
1	Dandagaun, VDC, ward no. 7, Myagdi District	2/12/2014	S. Bi.Ka	Housewife
			P. Bi.Ka	Housewife
			S. Bi.Ka	Housewife
			G. Bi.Ka	Housewife
			B. Bi.Ka	Housewife
			D. Bi.Ka	Housewife
			C. Bi.Ka	Mistri
			L. Bi.Ka	Mistri
			S. Bi.Ka	Student
			S. Bi.Ka	Mistri
			S. Bi.Ka	Labour
			C. Bi.Ka	Famer
			T. Bi.Ka	Mistri
			S. Bi.Ka	Housewife
			K. Bi.Ka	Housewife
			K. Bi.Ka	Housewife
			A. Bi.Ka	Housewife
			L. K. Bi.Ka	Housewife
			S. Bi.Ka	Housewife
			D. Tulachan	Housewife
			K. Tulachan	Housewife
2	Pokherbala, Ghar VDC, ward no. 4, Myagdi	2/13/201	G. Baruwal	Agriculture
			O. Baruwal	Agriculture
			S. Baruwal	Agriculture
			M. Khadka	Agriculture
			G. Thapa	Agriculture
			S. Hirachan	Agriculture
			P. Baruwal	Student
			L. Bhandari	Agriculture
			G. Khatri	Agriculture
			D. Baruwal	Agriculture
			S. Baruwal	Student
			L. Bhandari	Agriculture
			K. Baruwal	Agriculture
			D. Baruwal	Agriculture
			S. Gaburja	Agriculture

			N. Paija	Agriculture
			J. Baruwal	Agriculture
			K. Khatri	Agriculture
			K. Giri	Agriculture
3	Tilpling, Begkhola VDC, ward no. 9 Myagdi District	2/14/2014	S. Purja	Famer
			S. Gurbuja	Teacher
			P. Tilija	Business
			T. Gurbuja	Famer
			G. Gurbuja	Student
			G. Gc	Agriculture
			R. Purja	Agriculture
			R. Purja	Hotel
			D. Sijali	Agriculture
			Sk. Purja	Teacher
			J. Amarja	Teacher
			K. Purja	Agriculture
			D. Purja	Teacher
			G. Tilija	Teacher
			M. Thapa	Business
			B. Gouchan	Business
			U. Gouchan	Business
			N. Magar	Agriculture
4	Ranipauwa, Pipla VDC, ward no. 4, Myagdi	2/16/2014	D. Shahi	Agriculture
			G. Shahi	Agriculture
			A. Shahi	Agriculture
			R. Malla	Agriculture
			P. Malla	Agriculture
			S. Shahi	Agriculture
			A. Shahi	Agriculture
			S. Shahi	Agriculture
			P. KC	Agriculture
			B. KC	Agriculture
			C. Bi.Ka	Agriculture
			B. Malla	Agriculture
			G. Bi.Ka	Agriculture
			N. KC	Agriculture
			L. KC	Agriculture
			D. KC	Agriculture
			P. Bi.Ka	Agriculture
			P. Chanda	Agriculture
5	Chourphata, Majphate VDC, ward	2/18/2014	T. JC	Agriculture

	no. 7, Myagdi District			
			B. JC	Business
			T. JC	Business
			C. Khatri	Agriculture
			B. Bi.Ka	Agriculture
			D. JC	Agriculture
			Y. JC	Teacher
			D. JC	Teacher
			P. Bhandari	Agriculture
			B. JC	Agriculture
			N. Chetri	Student
			M. Chetri	Student
			O. JC	Agriculture
			A. Chetri	Teacher
			N. JC	
			R. Chetri	Teacher
			B. JC	Unemployee
6	Pherse, Naglibang VDC, ward no. 9, Parbat District	2/19/2014	H. B. Khatri	Agriculture
			T. Regmi	Business
			C. Upadhaya	Agriculture
			G. KC	Agriculture
			P. Giri	Student
			S. Regmi	
			G. Regmi	Agriculture
			J. Sapkot	Agriculture
			S. Khatri	Agriculture
			R. Sapkot	Agriculture
			K. Kadal	Business
7	Badahau, Pang VDC, ward no. 4, Parbat District	2/20/2014	K. P. Rijal	Services
			R. R. Upadhaya	Agriculture
			G. P. Rijal	Agriculture
			B. B. Nepali	Agriculture
			H. B. Nepali	Agriculture
			B. B. Malla	Agriculture
			D. B. Chetri	Unemployee
			R. R. Capagai	Services
			C. L. Poudyal	Murtikar
			S. P. Upadhaya	Agriculture
			K. Poudyal	Agriculture
			D. Rijal	Agriculture
			K. Sharma	Agriculture
			T. B. Sudedi	Agriculture

			T. B. Pariyar	Services
			K. B. Kuwar	Agriculture
			B. Bahadur	Agriculture
			S. P. Poudyal	Business
8	Tallo Sarangi, Amallchour VDC, ward no. 9, Baglung District	2/22/2014	K. B. Khatri	Agriculture
			D. B. Khatri	Agriculture
			D. P. Padhaya	Agriculture
			K. Lamichane	Business
			D. K. Acharya	Agriculture
			S. Acharya	Agriculture
			I. K. Acharya	Agriculture
			H. KC	Agriculture
			D. D. Padhaya	Agriculture
			B. Lamichane	Student
			J. Lamichane	Student
			B. Acharya	Business
			B. Lamichane	Agriculture
			K. Sharma	Agriculture
			E. N. Chapagai	Agriculture
9.	Satbisha, Paiuepata VDC, ward no. 1, Baglung District	2/23/2014	D. N. Sharma	Teacher
			R. Poudyal	Agriculture
			K. Poudyal	Agriculture
			L. Poudyal	Agriculture
			L. Poudyal	Agriculture
			B. Poudyal	Services
			S. Poudyal	Social Mobilizer
			P. Sharma	Agriculture
			L. D. Padhaya	Agriculture
			B. Poudyal	Student
			D. Sharma	Agriculture
			L. Bhetwal	Agriculture
			G. D. Sharma	Agriculture
			M. Poudyal	Student
			S. Sharma	Agriculture
			H. Poudyal	Agriculture
10	Hatiya, Narayansthan VDC, ward no. 5, Baglung District	2/24/2014	H. N. Shrestha	Services
			K. K. Shrestha	Housewife
			U. L. Shrestha	Agriculture
			L. B. Shrestha	Agriculture

			N. B. Shrestha	Agriculture
			P. B. Shrestha	Agriculture
			D. B. Shrestha	Agriculture
			N. Shrestha	Forigen Employeement
			K. P. Shrestha	Agriculture
			K. Shrestha	Agriculture
			B. K. Shrestha	Agriculture
			N. B. Shrestha	Agriculture
			K. B. Shrestha	Agriculture
			T. K. Shrestha	Housewife
			S. Pradhan	Housewife
			K. K. Shrestha	Housewife
			B. K. Shrestha	Housewife
			A. Shrestha	Housewife
			P. Shrestha	Housewife
			J. Dhakal	Housewife
			P. Shrestha	Housewife
			H. Shrestha	Housewife
			D. Shrestha	Housewife
11	Aakghu, Modikuwa VDC, ward no. 2, Parbat District	2/25/2014	D. Regmi	Services
			B. Bhusal	Teacher
			B. Prasad	hotel
			T. P. Gimire	Famer
			L. H. Godel	Teacher
			H. B. Nepali	Agriculture
			B. K. Godel	Agriculture
			A. Poudyal	hotel
			A. Bi.Ka	Agriculture
			D. Regmi	Agriculture
			P. Godel	Agriculture
			A. Nepali	
			N. Poudyal	Business
			R. Godel	Business
			T. Godel	Agriculture
			N. Poudyal	Agriculture
12	Karnas Bala, Danglang VDC, ward no. 7, Parbat district	2/26/2014	A. Nepali	Labour
			S. Sunar	Labour
			J. Nepali	Labour
			R. Pariyar	Labour
			K. B. Nepali	Agriculture

			T. B. Nepali	Agriculture
			J. B. Nepali	Agriculture
			A. Choudhari	Labour
			R. Pandey	Agriculture
			B. B. Kuwar	Agriculture
			K. B. Nepali	Agriculture
			R. K. Pathak	Business
			D. P. Pathak	Business
			G. P. Pathak	Agriculture
			B. B. Kuwar	Agriculture
			P. Kuwar	Agriculture
13	Thouha, Barachour VDC, ward no. 2, Parbat district	2/27/2014	D. Dhakal	Business
			U. Parajuli	Agriculture
			M. D. Dhakal	Agriculture
			D. Thapa	Agriculture
			B. Parajuli	Agriculture
			T. D. Parajuli	Agriculture
			G. Gurung	Business
			G. Poudyal	Agriculture
			S. Parajuli	Agriculture
			K. Parajuli	Student
			S. Giri	Agriculture
			K. D. Sharma	Services
			H. N. Parajuli	Teacher
			R. Giri	Services
			H. Dhakal	Agriculture
			N. Parajuli	Agriculture
			N. Thapa	Agriculture
14	Thati, whalci VDC, ward no. 9, Parbat district	2/27/2014	T. Bhattarai	Agriculture
			S. R. Bhattarai	Teacher
			N. Shrestha	Agriculture
			T. Bhattarai	Agriculture
			R. Bhattarai	Business
			R. Shrestha	Business
			P. Bhattarai	Agriculture
			K. Bhattarai	Agriculture
			B. Bhattarai	Agriculture
			R. Shrestha	Agriculture
			S. Bhattarai	Agriculture
			N. Bhattarai	Agriculture
			A. Bhattarai	Agriculture
			L. Shrestha	Agriculture

			P. Bhattarai	Agriculture
			S. Bhattarai	Agriculture
15	Dawali, Uremi VDC, ward no. 1, Parbat District	2/27/2014	K. B. Thapa	Agriculture
			Y. Thapa	Agriculture
			R. B. Thapa	Agriculture
			H. Thapa	Agriculture
			S. Thapa	Student
			N. B. Thapa	Student
			H. P. Nepali	Agriculture
			R. Nepali	Agriculture
			S. Nepali	Agriculture
			G. Poudyal	Agriculture
			H. D. Poudyal	Agriculture
			S. Bhattarai	Agriculture
			S. Bhattarai	Agriculture
			R. P. Bhattarai	Agriculture
16	Jogimara, RidiKhola VDC, ward no , Syanja District	2/28/2014	P. B. Chetri	Agriculture
			G. B. Chetri	Agriculture
			B. Chetri	Agriculture
			S. Chetri	Agriculture
			N. B. Thapa	Agriculture
			E. B. Chetri	Agriculture
			S. B. Chetri	Agriculture
			B. Chetri	Agriculture
			G. B. Bastyal	Agriculture
			T. B. Chetri	Agriculture
			K. Chetri	Agriculture
			R. Chetri	Student
			L. Chetri	Agriculture
			P. Chetri	Agriculture
			P. Chetri	Agriculture
			H. B. Chetri	Teacher
17	Bagathala, Nibuwalhukhe VDC, ward no. 2, Syanja District	3/1/2014	T. R. Naupane	Agriculture
			D. B. Magar	Agriculture
			N. P. Naupane	Agriculture
			J. B. Magar	Agriculture
			P. Neupane	Business
			D. M. Thapa	Agriculture
			M. K. Neupane	Agriculture

			B. K. Thapa	Agriculture
			P. K. Thapa	Agriculture
			M. Thapa	Agriculture
			T. K. Thapa	Agriculture
			M. Thapa	Agriculture
			A. Thapa	Agriculture
			G. Neupane	Agriculture
			B. Thapa	Student
			B. Neupane	Teacher
			I. L. Thapa	Agriculture
			S. Thapa	Student
			C. Neupane	Student
			Y. B. Thapa	Student
			S. Thapa	Student
18	Chapapani, Chapapani VDC, ward no. 7, Palpa District	3/3/2014	E. P. Dhakal	Secetery
			S. Bastyal	Social Mobilizer
			A. Gimire	Services
			S. Parajuli	Agriculture
			D. P. Bhattarai	Agriculture
			A. Thapa	Agriculture
			C. P. Dhakal	Business
			P. Thapa	Business
			S. Thapa	Business
			P. K. Thapa	Business
			P. Bhattarai	Business
			S. Dk	Business
			B. Bi.Ka	Agriculture
19	Pipa, Chitrungdhare VDC, ward no. 2, Chitrungdhare	3/4/2014	S. P. Bastyal	Agriculture
			K. P. Pandey	Agriculture
			M. Bastyal	Agriculture
			S. Pandey	Services
			K. K. Khanal	Agriculture
			N. Pandey	Agriculture
			L. Pandey	Agriculture
			K. Bastyal	Agriculture
			D. Pandey	Agriculture
			M. Pandey	Agriculture
			B. Deri	Agriculture
			D. Naupane	Agriculture
			M. Pandey	Agriculture

			S. Gair	Agriculture
20	Khirouli, Karni VDC, ward no 7, Palpa District	3/4/2014	M. Shrestha	Agriculture
			S. Kumar	Agriculture
			P. P. Shrestha	Business
			A. Shrestha	Student
			Y. P. Thapa	Agriculture
			D. P. Chidi	Agriculture
			R. D. Thapa	Agriculture
			L. Shrestha	Business
			P. Kumal	Agriculture
			B. B. Pariyar	Agriculture
			T. B. Sarki	Agriculture
			B. S. Kumrel	Agriculture
			J. B. Thapa	Agriculture
			S. D. Pariyar	Agriculture
			N. Sarki	Agriculture
21	Bijamchour, Koldada VDC, ward no. 2, Palpa District	3/5/2014	D. B. Aale	Agriculture
			B. B. Chouhan	Teacher
			M. B. Chouhan	Agriculture
			G. S. Rana	Agriculture
			P. Aale	Agriculture
			K. Chouhan	Agriculture
			M. Rana	Agriculture
			D. B. Aale	Agriculture
			G. B. Aale	Agriculture
			T. Aale	Agriculture
			D. B. Rana	Agriculture
			R. B. Rana	Agriculture
			R. Rana	Agriculture
			D. B. Thapa	Services
22	Dadiwa, Doban VDC, ward no. 2, Palpa District	3/7/2014	H. B. Magar	Agriculture
			M. Aale	Business
			H. S. Aale	Agriculture
			B. B. Kausa	Agriculture
			S. B. Aale	Agriculture
			B. M. Tarami	Agriculture
			O. B. Tarami	Agriculture
			K. D. Magar	Agriculture
			P. N. Poudyal	Agriculture
			K. B. Magar	Agriculture

			K. Aale	Agriculture
			T. Magar	Agriculture
			B. Magar	Agriculture
23	Mudaban, Devdeha VDC, ward no. 9, Rupandehi District	3/7/2014	D. R. Gimire	Agriculture
			M. B. Thapa	Agriculture
			J. B. Thapa	Agriculture
			B. B. Thapa	Agriculture
			C. K. Gimire	Agriculture
			D. M. Thapa	Agriculture
			R. Resmi	Agriculture
			D. K. Thapa	Agriculture
			J. M. Pulali	Agriculture
			C. Resmi	Agriculture
			N. Palli	Agriculture
			L. M. Resmi	Agriculture
			K. B. Thapa	Agriculture
			Y. B. Thapa	Agriculture
			K. B. Resmi	Agriculture
			G. B. Thapa	Agriculture
			B. B. Thapa	Agriculture
			S. Magar	FE
			D. Thapa	Agriculture
			H. L. Gimire	Agriculture
			N. B. Sarbuja	Agriculture
			B. B. Magar	Agriculture
			B. B. Thapa	Agriculture
24	Bhupurainik Tol, Makarhar VDC, ward no. 6, Rupandehi District	3/5/2014	T. R. Thapamagar	Agriculture
			K. B. Thapa	Agriculture
			J. D. Chantel	Agriculture
			K. K. Gurung	Agriculture
			C. M. Gurung	Agriculture
			B. K. Thapamagar	Agriculture
			L. P. Magar	Agriculture
			G. P. Magar	Agriculture
			S. Bam	Agriculture
			K. D. Shahi	Agriculture
			B. M. Gurung	Agriculture
			I. Chetri	Agriculture
			H. K. Gurung	Agriculture
			R. Ranamaar	Agriculture
			I. T. Magar	Agriculture

			M. P. Magar	Agriculture
			L. Gurung	Agriculture
			K. Bam	Business
			B. Giri	Agriculture
			R. P. Magar	Agriculture
			T. Thapamagar	Business
			K. Thapamagar	Agriculture

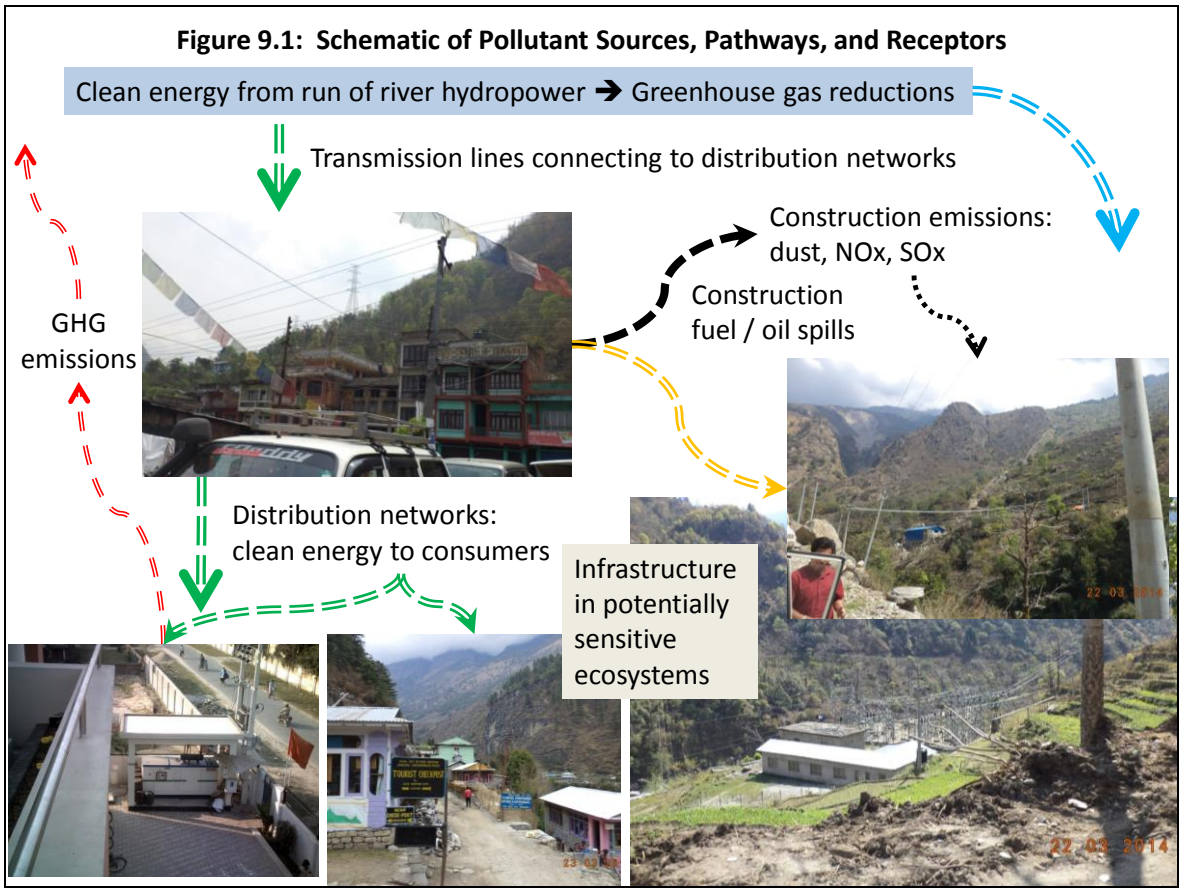
9. Anticipated Impacts and Mitigation Measures

Environmental impacts will vary for each of the distribution lines and substations, but are expected to be minimal due to the small footprint of the facilities. The Nepali regulatory framework does not specifically require an IEE or EIA for individual distribution lines less than 33 kV rated capacity. This volume of the project IEE covers the distribution component of the SPEP Project, and the EMP for distribution provides the key guidance for additional survey work to update the IEE as well as for project implementation. This section provides a consolidated discussion based on desk studies and field reconnaissance conducted in 2013 and 2014.

The project activities comprise clearing of right-of-way, installation and construction of new distribution poles and substations, and augmentation of existing substations. Disturbance during construction will arise from temporary access road construction, clearing of vegetation, equipment staging, construction of substations, installation of distribution poles, and stringing of conductors on the poles. The potential impacts will occur mainly during construction due to minor earthworks, equipment staging, and temporary construction camps. The anticipated impacts are mostly localized, minimal, temporary, and reversible, and can be readily mitigated.

The potential impacts are illustrated conceptually in Figure 9.1, showing possible pollutant sources, pathways, and receptors. Distribution systems are generally considered to be "non-polluting" as there are no emissions of air pollutants, wastewater, or solid wastes associated with distribution lines; however, there are domestic wastes from larger substation operations, especially those with human operators present on a regular basis.

Figure 9.1: Schematic of Pollutant Sources, Pathways, and Receptors



The project will have long-term benefits by delivering reliable power to currently un-served and under-served areas, connecting clean energy capacity to end-users, reducing load shedding, and reducing reliance on diesel-fired generators and traditional biomass. The project will create short-term employment opportunities during construction, mostly for unskilled and semi-skilled labor.

The distribution component includes: (i) 410 km of 33 kV lines, (ii) 545 km of 11 kV lines, (iii) 725 km of 400 V lines, (iv) 31 new substation with total capacity of 216 megavolt-amps (MVA), and (v) 431 transformers for upgrade of existing substations. The total footprint of these facilities is estimated at 755.25 ha, as shown in Table 9.1. There are several subprojects located in or which impinge on conservation areas, Important Bird Areas (IBA), protected areas, or other areas of environmental sensitivity. The total length and area of the subprojects in with potential environmental sensitivity is less than 370 km and less than 176.25 ha; this represents about half of the total length of distribution lines but only about 23% of the total footprint. The estimated length and area are skewed significantly by the 70 km Dharan-Dhankuta-Hile 33 kV distribution line: Dharan Bazaar is located in the IBA named Dharan Forest, so part of the line is assumed to be in this IBA; the estimated lengths and area with environmental sensitivity assumes that the entire 70 km of this line is in the IBA, which is not the case but which is presented to provide an upper limit of the potential impact on sensitive environments.

Table 9.1: Distribution System "Footprint"

Components	Right-of-way	Total Area (ha)	Potential Environmental Sensitivity
410 lm of 33 kV lines	6 m	246	< 145 km / < 87 ha
545 km of 11 kV lines	4.5 m	245.25	95 km / 42.75 ha
725 km of 400 V lines	3 m	217.5	130km / 39 ha
31 substations	1.5 ha	46.5	5 substations / 7.5 ha
Total Footprint		**755.25**	**< 370 km, < 176.25 ha**

Source: NEA Distribution System proposal and ADB PPTA estimates

Preliminary summary of potential impacts and mitigation measures for these environmentally sensitive areas are presented in Table 9.2. In all cases, routing options will be identified at the detailed survey stage, with lines and substations located away from forested areas and potentially sensitive habitats to the maximum extent possible. Tree replacement will be at 25:1. Biodiversity offsets may be considered as a last resort.

Table 9.2: Potentially Sensitive Locations, Impacts, and Mitigation Options

Subproject	Potentially Sensitive Ecosystem	Potential Impacts	Mitigation Options
Sakranti Bazaar S/S, Tehrathum District 33 kV – 5 km 11 kV – 20 km 400 V – 20 km 3 MVA S/S with 10 transformers	IBA Tamur Valley and Watershed Part of District is in Kanchenjunga Conservation Area (KCA)	Potential disruption of bird migration pathways Possible disturbance of sensitive ecosystems due to ROW clearing	• Avian markers and/or other bird diverters • Minimize RoW impact by siting adjacent to existing roads • Increase pole height to allow re-vegetation to grow up to 1 – 2 meters high, facilitating migration
DSR at Tehrathum, Taplejung District 11 kV – 20 km 400 V – 40 km 10 transformers	IBA Tamur Valley and Watershed Part of District is in Kanchenjunga Conservation Area (KCA)	Potential disruption of bird migration pathways Possible disturbance of sensitive ecosystems due to ROW clearing	• Avian markers and/or other bird diverters • Minimize RoW impact by siting adjacent to existing roads • Increase pole height to allow re-vegetation to grow up to 1 – 2 meters high, facilitating migration

Subproject	Potentially Sensitive Ecosystem	Potential Impacts	Mitigation Options
Dharan-Dhankuta – Hile 33 kV -- 70 km	IBA Dharan Forest	Potential disruption of bird migration pathways Potential bird electrocution	• Avian markers and/or other bird diverters
Laharepauwa S/S, Rasuwa District 33 kV – 20 km 11 kV – 10 km 400 V – 10 km 3 MVA S/S with 10 transformers	Buffer zone of Langtang National Park	Disturbance of potentially sensitive ecosystems in buffer zone	• Minimize RoW impact by siting adjacent to existing roads • Increase pole height to allow re-vegetation to grow up to 1 – 2 meters high, facilitating migration
Sedhwa S/S, Parsa District 33 kV – 20 km 11 kV – 20 km 400 V – 20 km 8 MVA S/S with 10 transformers	TCL Priority Landscape	Potential disruption of tiger migration pathways	• Increase pole height and allow re-vegetation to grow up to 1 – 2 meters high, facilitating migration
Dhakdhahi S/S, Rupandehi District 33 kV – 20 km 11 kV – 20 km 400 V – 20 km 8 MVA S/S with 20 transformers	Bird migration area: sarus crane habitat 4 -10 km from town	Potential disruption of bird migration pathways Anecdotal reports of Sarus crane electrocution in general vicinity	• Avian markers and/or other bird diverters
Lapani S/S, Kapilbastu District 33 kV – 10 km 11 kV – 20 km 400 V – 20 km 8 MVA S/S with 15 transformers	IBA Farmlands of Lumbini: sarus crane habitat 4 -10 km from town of Lapani	Anecdotal reports of Sarus crane electrocution in general vicinity	• Avian markers and/or other bird diverters
Upgradation of Bhairahawa S/S 11 kV – 5 km 16 MVA S/S	IBA Farmlands of Lumbini: sarus crane habitat 4 -10 km from town of Bhairahawa	Anecdotal reports of Sarus crane electrocution in general vicinity	• Avian markers and/or other bird diverters
DSR in Gorkha, Syanja, and Parbat Disricts	Gorkha District is partly within Manaslu Conservation Area (MCA) Syanja and Parbat impinge on Panchase Forest	Disturbance of potentially sensitive ecosystems in MCA and Pachase Forest during construction	• Minimize RoW impact by siting adjacent to existing roads • Increase pole height to allow re-vegetation to grow up to 1 – 2 meters high, facilitating migration

DSR = distribution system reinforcement, IBA = Important Bird Area, KCA = Kunchanjunga Conservation Area, km = kilometers, kV = kilovolts, MCA = Manaslu Conservation Area, MVA = megavolt-amperes, ROW = right of way, S/S = substation, TCL = Tiger Conservation Landscape, V = volt Note: Findings are preliminary and will be updated.

Source: NEA and ADB PPTA team

Design Principles and Construction Methods

The right-of-way (ROW) for 33kV, 11kV and 400/230V distribution lines are not specifically fixed in the Nepali regulatory framework. The Electricity Regulation 2050 of GoN mentions the minimum clearances needed between the conductor and house or tree, which are 2 m for 33 kV and 1.25 m for 11 kV and 400/230 V distribution lines. Taking into consideration of line spacing between two conductors, minimum clearances on either side of the line and swing of the line due to wind, ROW for 33 kV, 11 kV and 400/230 V distribution lines may be taken as 6 m, 4.5 m and 3 m respectively. Typically, a distribution substation will have a switch yard, control room and office space with a small store and some parking space for vehicles. The size of land area varies widely but for general estimation purpose, an area of 1.5 hectares is used for purposes of estimation.

Most of the 33 kV, 11 kV and 400/230 V distribution lines are pole mounted overhead lines. There would be some underground 33 kV cables for connection to the distribution substation. Likewise, some length of 11 kV underground cable will be needed for incoming and outgoing feeders at the distribution substation, some for crossing other transmission and sub-transmission lines and also for some congested areas with inadequate clearances and also for avoiding tree cuttings in some green areas. Usually, Aerial Bundled Conductor (ABC) cables are used for 400/230 V distribution lines to prevent electricity theft by hooking, to minimize leakage of electricity due to contact with tree branches and to reduce line faults.

The poles used for 33 kV and 11 kV lines are Pre-stressed Concrete (PSC) poles and Steel Tubular Poles whereas, for 400/230 V distribution lines, apart from PSC poles and steel tubular poles, treated wooden poles are also used widely. The PSC poles are heavy and need cranes for erection and so they are normally used by the side of motor able roads. For off road areas, the steel tubular poles are commonly utilized.

Prior to construction, line survey is undertaken and location of poles and distribution transformers are spotted. Site clearances are made by cutting trees and branches. The line materials such as poles, conductors, insulators and fittings and transformers are transported by trucks from staging areas to the construction sites. In the hilly areas without roads, the materials are transported by manual labor. Soil excavation for erection of poles is done by auger crane, if available; otherwise done manual excavation is performed using picks and shovels. In case of Steel Tubular Poles, a concrete collar is placed around the pole to a specified length above and below the ground level. The cross arms, insulators and fittings are fixed manually by electricians and helpers climbing the poles using ladders. The conductor stringing is done by pulling the conductor from the conductor drum by using pulleys and winches. For the installation of distribution transformers, cranes are employed wherever possible, otherwise, it is done using winches and pulleys.

In case of underground cables, cable trenches are dug by soil excavation up to a specified depth. The trench is filled with sand to a depth of at least 100 mm. The underground cable is laid in the trench by pulling the cable from the cable drums by people using cable rollers placed conveniently in the trench. The cable is covered by a layer of sand at least 200 mm thick. A layer of bricks are placed in the sand layer above the cable. The trench is back filled by excavated soil and compacted adequately. The cable jointing wherever required and cable terminations are done properly using standard cable jointing and cable termination kits. Usually, a spare loop of cable is provided underground beside the pole with cable termination. For road crossing, cables are laid inside steel reinforced concrete pipes or high density polythene pipes of adequate diameter.

The size of construction crew depends upon site conditions and the volume of works. Typically, a crew size of 15 to 20 people will be employed per site. The duration of construction work for a distribution line sub-project depends upon size of the sub-project and also on the terrain of the construction site. Compared to the hilly terrain, construction works in

terai plains are easier and can be accomplished faster. Typically, around 2-3 weeks time period will be needed for the construction of one kilometer of 33 kV, 11 kV and 400/230 V distribution lines without mechanized equipment. For a typical distribution line sub-project, 15 months construction period may be assumed. Whereas in the case of new distribution substation, a time period of 18 months may be considered including the procurement of equipment. However, various distribution line sub-projects and distribution substations can be taken in parallel by using multiple construction groups and contractors.

The likely adverse impacts during design, construction, and operation of the distribution lines and substations relative to existing baseline conditions are discussed below in terms of physical, biological and socio-economic and cultural environment, and split into the (i) design and construction phase (noted below simply as "construction" phase), and (ii) operation phase. [Individual distribution lines and substations are referred to as "subprojects."]

9.1 Physical Environment

The main physical impacts arise from land use for pole installation, conductor stringing, and equipment staging. Impacts are localized, short term, and reversible, except for small areas where vegetation clearing is required and where sensitive receptors may be present.

9.1.1Topography, Land use and Land Take

9.1.1.1 Construction Phase

The land use changes are due to the temporary land acquisition along the right-of-way (ROW) and for installation of poles which require permanent land use changes. ROW will be minimized by routing lines adjacent to existing roads wherever possible. The permanent land use changes may result in loss of agricultural production in the cultivated land and forest resources. The ROW constitutes land fragmentation. Each pole will disturb a surface area of about 1 m^2. A maximum of 2 ha of land is required for each substation, with 1.5 ha expected on average. Up to 2 ha may be required temporarily for construction camps. The impact is classified as moderate in magnitude, local in terms of area or geographic extent, and of short-term duration during construction.

9.1.1.2 Operation Phase

Use of land in the ROW is restricted to agriculture and similar activities which do not interfere with the poles and conductors. Construction of dwellings and permanent human habitation is not allowed in the ROW. All temporary land acquired will be converted to its original use or agreed new uses towards the end of the construction period. The impact can be classified as high in magnitude due to the permanent nature of the facilities, local in terms of extent, and of long-term in terms of duration.

9.1.2Watershed and Drainage

The distribution lines are mostly located in hilly regions. Interference with drainage patterns during construction will be minimized due to the very small footprint of individual poles. Substation sites will result in minor alteration of drainage patterns.

9.1.2.1 Construction Phase

The impact due to site clearing, stringing of the lines, excavation for pole installation and material transportation may disturb watershed condition, but the impact will be minimal as disturbance is limited to approximately 1 m^2 of land for each pole and up to 2 ha for each substation. Therefore no significant impact is expected. The cultivated area around the poles may be affected due to compaction during the construction and transportation of materials but this will be limited to a few square meters per pole.

Poles and lines will be located away from rivers and streams to minimize disturbance on water flow and to minimize the risk of flood damage to the poles. Overall disruption of natural

drainage will be insignificant. The impacts are site specific, low in magnitude and for a short duration.

9.1.2.2 Operation Phase

Physical disturbances during operation are essentially non-existent. No significant impact on the watershed, soil, and geology is expected during the operation and maintenance period. New and improved electricity supplies will reduce demand for traditional biomass; this should have the beneficial effect of reduced deforestation which will improve water retention in soils.

9.1.3 Air Quality

9.1.3.1 Construction Phase

The impact on air quality during the construction period is expected to be insignificant, as site clearance, excavation, and concreting are localized and short term. Transportation of the materials and movement of construction crews and equipment will cause minor impact on air quality, mainly due to dust and vehicle exhaust emissions. The impacts are low in magnitude, site-specific, and short duration.

9.1.3.2 Operation Phase

No air impacts are expected during the operation phase. Emissions from substations are limited to vehicle traffic associated with staff going to and from work. New and improved electricity supplies will reduce demand for traditional biomass, and emissions from burning wood and animal dung will be reduced as consumers switch to electricity for cooking.

9.1.4 Noise and Vibration

9.1.4.1 Construction Phase

The emission of noise and vibrations are inevitable during construction. Unfortunately, distribution lines and substations are intrusive in communities, and ROW options are limited with respect to avoiding settlements. Impacts will be arise from vehicular movement and construction activities, but will be temporary and represent only a minor increase in disturbance above prevailing traffic conditions on existing roads. The impact is expected to be low in magnitude, site specific and for a short duration.

9.1.4.2 Operation Phase

Overhead distribution lines do create some noise in certain circumstances: minor surface damage, dirt or some weather conditions can cause the lines to crackle or hum slightly, which is known as corona effect. Corona effect is conspicuous during rain (but is much less noticeable for distribution lines of 33 kV and lower voltage ratings compared to high-voltage transmission lines). Noise impacts are minimized by maintaining mandatory set-back distance from buildings and other settlements. The impact is expected to be low in magnitude, long termed and site specific.

9.1.5 Water Quality

9.1.5.1 Construction Phase

During the construction period, water will be used from nearby rivers and streams as necessary. Therefore, there is possibility of water pollution especially where lines cross streams and where poles are situated where run-off can enter a stream or river. Soil disturbances associated with pole installation, the improper disposal of solid wastes and materials such as cement slurry, construction materials, and human wastes may cause temporary deterioration of water quality. There is a potential for water borne diseases in villages where flowing streams are used for household chores. The impact is expected to be moderate in magnitude, site specific and for a short duration.

9.1.5.2 Operation Phase

The operation and maintenance activities of the distribution lines will not impact water quality. Domestic wastes from substations may impact surface and groundwater. Potential impacts are limited in magnitude and extent, but are long-term.

9.2 Biological Environment

9.2.1 Vegetation/Forest Resources

9.2.1.1 Construction Phase

Impacts on ground flora and fauna accrue form clearing vegetation in the ROW, specifically for poles and substation sites. Substations and ROW will avoid forested areas to the extent possible. In terms of area / geographic extent, the overall magnitude of impact on vegetation is considered to be low, and impacts are largely short-term and reversible, as vegetation will be avoided to the extent possible and in any case will be allowed to re-grow in the ROW while maintaining vertical and horizontal clearance of at least 1.25 meters from conductors.

Clearance of ROW

During the construction period almost all the trees having more than 10 cm diameter-at-breast-height (dbh) will be cleared for the construction and erection of the distribution lines and substations. The total number of trees will be determined during pre-construction surveys and by counting and recording during construction of the individual distribution lines and substations.

Harvesting of Non-Timber Forest Products (NTFP)

The proposed project does not directly affect the NTFPs of the sub-project vicinities and no impact is envisaged for NTFP. The project areas are generally not rich in valuable NTFP and the magnitude of impact is considerable to be low. Extent is local and duration is short term.

Increase in Demand for Fuel Wood and Timber

Skilled, unskilled and semi skilled labor will be involved in the construction period. Most of the labor force will come from the project areas, but there will be some people employed during construction from outside the project area for short period to time. Potential increase in demand of fuel wood and timber during the construction period is expected to be very low. Moreover, there will be no permanent settlements leading to encroachment on forest land. The impact is be considered to be low in magnitude, site specific and short termed.

9.2.1.2 Operation Phase

Clearance of ROW

Vegetation in the ROW will be allowed to re-grow while still maintaining compatible clearance with conductors for safe operation. Vegetation will be trimmed every 3-4 years to maintain the required vertical and horizontal clearances. ROW clearance will not only change the vegetation cover but also will alter the ecological condition to some extent.

However, the overall operation phase impact on vegetation will be low because once the ROW is cleared, frequent trimming is not required. The extent is site specific and duration is long term.

Increased Access to Forest

The clearance of ROW in the forest land may provide easy access to local people for the intrusion of forest and its products. The magnitude of impact is considered to be low because most of the forest in the project area belongs to community, or is leasehold forest which is managed by the community forest user groups. Furthermore, strict rule and regulation and monitoring by the user groups will also control the unnecessary encroachment. This activity will not have a noticeable effect on the forest and vegetation.

9.2.2Disturbance to Wildlife

9.2.2.1Construction Phase

The degree of impact on wild animals depends entirely on the species present, vegetation type and abundance of food. Possible impacts on wildlife population due to the project construction will be minimized by careful routing.

Loss of Habitat

Impact on wildlife habitat is related to loss of vegetation due to ROW clearing and substation construction. The forested area to be cleared relative to the total footprint will be determined during line surveys and spotting of substation sites. As a matter of policy and good engineering design, forested areas will be avoided to the maximum extent possible, although some clearing of vegetation will be required. Comparing the forested area to be cleared to the total footprint, the magnitude of impact is considered to be low, extent is site-specific, and duration is long term (see further discussion on biodiversity below).

Avian hazards

Overhead distribution lines constitute a persistent threat to birds, although this is minimal compared to high-voltage transmission lines. Impact on avian fauna is expected to be moderate to high in low visibility conditions, especially bad weather and night time, but it is very difficult to quantify the risks. Except for areas within a few kilometers of Important Bird Areas (discussed above at Table 9.2), the magnitude of impact is expected to be low, extent is site specific and duration is long time.

Hunting and poaching by Labor Force

Hunting and poaching is a possibility due to the presence of construction workers. The possibility of hunting and trapping by workers during construction period will be site-specific and will decrease once the work is completed. The overall magnitude of impact is considered to be low, extent is site specific and duration is short period.

Overall Impacts on Biodiversity

Impacts on biodiversity have been assessed by mapping the proposed distribution routes with respect to (i) protected areas and other potentially sensitive habitats, (ii) habitat ranges (e.g., Appendix 2), (iii) forested areas, and (iv) land use zoning in the potentially affected protected areas; the various figures in Section 4 and the Appendices present these aspects of the assessment. Reconnaissance inspections have been conducted in June and December 2013 and March 2014, and preliminary and detailed route surveys have also been reviewed. The IEE which has been completed for the Markichowk-Kathmandu line has also been reviewed.

This assessment process has identified potential “hot spots” where the habitat ranges of sensitive species may be intersected by the proposed distribution subprojects, as summarized in Table 9.2 above. Preliminary mitigation options are also presented in Table 9.2. This assessment will be updated as the surveys are performed for individual distribution lines and substations and site selection is finalized.

9.2.2.2Operations Phase

Biodiversity impacts during operations are minimal, as the affected areas will return to a state of equilibrium as vegetation re-grows in the ROW. The impacts during operations are direct and site-specific, but long-term.

Further to the potentially sensitive areas summarized in Table 9.2 above, the impacts during operations may be concentrated to some extent in Kanchenjunga Conservation Area (KCA), the buffer zone of the Langtang National Park, and the Manaslu Conservation Area (MCA), as these areas were all established for biodiversity conservation. The potential impacts can be envisioned by a comparison of the potential project footprint relative to other infrastructure and

total areas of these protected areas, as summarized below in Table 9.3.

Table 9.3: Summary of Existing Infrastructure and Project Footprint in Protected Areas

Infrastructure	Footprint in KCA	Footprint in Langtang Buffer Zone [a]	Footprint in MCA [b]
Existing Roads – 2 lane, unimproved	135 km x 15 m = 202.5 ha	70 km x 15 m = 105 ha	60 km x 15 m = 90 ha
Existing Housing & other buildings	1800 households x 400 m^2 per household = 72 ha	1500 households x 400 m^2 per household = 60 ha	900 households x 400 m^2 per household = 36 ha
Estimated distribution right-of-way (ROW) in protected area	40.5 ha	21 ha	18 ha
Relative distribution footprint (ROW / total housing and roads)	40.5 / 243 = 16.7%	21 / 165 = 12.7%	18 / 126 = 14.3%
Relative distribution footprint (ROW / total conservation area)	40.5/ 203,500 = 0.0199 %	21 / 171,000 = 0.0123 %	18 / 166,300 = 0.0108 %

ha = hectare, KCA = Kanchenjunga Conservation Area, MCA = Manaslu Conservation Area, ROW = right of way
Source: ADB PPTA team
Note: [a] For preliminary estimate, the area of the National Park proper is used
[b] Proposed subprojects in MCA are distribution system reinforcement only; existing footprint to be estimated during pre-construction survey. MCA has 9000 inhabitants; assuming 5 people per household yields estimate of 1800 households.

9.3 Socio-economic and Cultural Environment

The key impacts arise from land acquisition, resettlement, social and cultural problems due to influx of labors, and economic spin-offs. Specifics of land acquisition and resettlement are covered in the resettlement and indigenous peoples plans for the project, which are stand-alone documents. The following discussion is therefore limited to general socio-economic and cultural impacts.

9.3.1 Health, Water Supply, and Sanitation

9.3.1.1 Construction Phase

Project area residents may experience some regular contact with the temporary labor force including outsiders. The temporary work force, especially temporary construction camps (if needed), may add further stress on the local health and sanitation situation. Communicable gastro-intestinal diseases such as diarrhea, dysentery, paratyphoid, worm as well as respiratory diseases, infection and haphazard discharge of wastes of various types including metals, paper, kitchen wastes etc., have the potential to degrade the sanitary hygienic conditions around construction areas and any construction campsites. Non-resident experts, technicians, and laborers from outside the project area may add additional pressure on local health and sanitation situation. The concentration of labor force may encourage prostitution which poses potential for spread of HIV/AIDS and other sexually transmitted disease. However, considering the small number of labors, typically about 15 to 20 people per crew, and short term presence at any given site the potential impacts are considered to be low, site specific and for short term.

Similarly, with the increase in temporary population along with the construction activities, will place additional demand on drinking water and existing sanitation facilities. The potential impacts on water supply and sanitary situation will be: shortage of drinking water, increase pressure on the existing water supply system, increase distance to the safe drinking water,

increase in disease vectors, and reduced water quality due to increased sanitation problems etc. However, given the size of construction crews relative to local communities, the impact on water supply and sanitation will be low, short term and site specific.

The lack of proper sanitary measures and increase in wastes and water pollution may lead to the outbreak of epidemic diseases such as jaundice, typhoid etc. Since, the local people will be employed as skilled, semi-skilled and labor to the extent possible, such impact is considered to be of moderate nature in magnitude, short–term and localized.

9.3.1.2 Operation Phase

No impacts are anticipated during the operation phase. After construction, the only increase in population will be the small labor force required for substation operations, which will be sourced from the project area to the maximum extent possible.

9.3.2 Occupational Hazards and Safety

9.3.2.1 Construction Phase

Work related injuries and vehicle accidents can be expected during the construction period. The magnitude of impact is low the extent is site specific and the duration is short termed.

9.3.2.2 Operation Phase

Nearby residents will be vulnerable to electrical hazards, including shocks, fires, or even electrocution. The public can be affected principally through their own activities, such as attempting to climb distribution poles, and illegally "hooking on" to distribution lines to avoid paying for metered electricity service. These risks should have low probability of occurrence, but are of great significance to individuals involved. The overall magnitude of impacts is considered to be low, extent is local, and duration is long term.

9.3.3 Electric and Magnetic Field Effect

9.3.3.1 Construction Phase

Impacts during construction are not expected. Potential impacts arise only after the distribution lines and substations are energized.

9.3.3.2 Operation Phase

Electric power distribution lines create electric and magnetic field together, referred to as electromagnetic fields (EMF). EMFs are created by the presence of voltage and are expressed in volts per meter (V/m), while magnetic field is produced by the present of current in the line and is expressed in terms of ampere per meter (A/m). EMFs are strongest beneath the lines and diminish rapidly with distance. Electrical field strength declines in inverse proportion to the square of the distance and magnetic field strength decreases in inverse proportion to the cube of the distance.[113] Research on the long-term effects of EMF associated with distribution line is inconclusive with respect to health risks. The magnitude of overall impact is considered to be low, extent is local and duration is long termed.

9.3.4 Religious, Historical and Archeological Sites

9.3.4.1 Construction Phase

Temples are quite common in Nepal and the project areas are no exception. However, distribution lines can be readily routed around temples and any cultural or archeological sites of significance. Re-routing as necessary will be determined by NEA field supervision teams and construction contractors. The potential impacts are moderate (given that temples are quite common), site-specific, and long term.

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[113] E.g., at a distance of 10 meters from a single distribution line or conductor, electrical field strength drops to 1% of the field strength at the conductor: 1/(10*10) = 1%. Likewise, the magnetic field strength drops to 0.1% of the field strength at the conductor: 1/(10*10*10) = 0.1%.

9.3.4.2 Operation Phase
No impact is expected during the operation phase.

9.3.5 Law and Order Due to Religious Differences
9.3.5.1 Construction Phase
During the construction of the distribution line labor from different places with different religion and faiths may be employed by contractor(s) and there will be possibilities of conflict of interest thus affecting the law and order situation. The past experiences reveal that local people have misunderstanding with the employer's and contractor's staff. Since the individual distribution subprojects are of small scale and local labor will be employed for construction activities, the likely impact on law and order situation due to project is low in magnitude, local and short termed.

9.3.5.2 Operation Phase
No significant impacts are expected during this phase.

9.3.9 Aesthetic Impacts
9.3.9.1 Construction Phase
Impacts are expected to be minimal and short term during construction.

9.3.9.2 Operation Phase
Impacts to visual resources are examined in terms of changes between the existing landscape character and proposed actions, sensitivity of viewing points available to the general public, their viewing distances and visibility of proposed changes.

Stringing of overhead lines with poles up to 5m high will cause visual changes to the existing landscape and scenery. The poles and wires are not unusually large, but are prominent due to proximity to consumers. Overall impact is considered to be moderate, and site-specific, but long term.

9.4 Beneficial Impacts

9.4.1 Local Employment
Local employment during the construction phase will be beneficial, but temporary. As noted above, the typical construction team will have 15 to 20 workers and distribution lines are expected to take 2-3 weeks per km of new line. Using these anticipate crew sizes and construction rates, the total labor required will range from 50,400 person-weeks to 100,800 person-weeks,[114] or 1008 person-years to 2016 person-years (assuming 50 weeks per year per full-time equivalent). About 30% of the labor force is expected to be local, i.e., 300 – 600 full-time equivalent positions for one year. The mobile workforce will be housed in temporary camps as necessary.

There will be 2 contract packages for the construction, and contractors will have some flexibility in determining the number of teams required; thus, it is not possible to determine an accurate number of employment opportunities at this time. Employment opportunities to some extent may check out-migration of the project area and promote in-migration. In this regard, the employment opportunities (along with access to electricity and improved electricity services) are expected to contribute to poverty alleviation. The magnitude of impact is considered to be moderate, extent is local, and duration is short term.

9.4.2 Local Economy

[114] Estimated as: 2 weeks/km x 15 people x 1680 km = 50,400 person-weeks; 3 weeks/km x 20 people x 1680 km = 100,800 person-weeks.

Employment opportunities, income from shop keepers, housing rental, increased demand for fresh vegetables, meat and rental/lease of land, etc. are possible sources of income during construction. Increased trade and business will inject significant cash into local economies. This short term economic gains will contribute to the development of local economy. The increase in business will enhance the economic status of local people. Project area residents will have opportunities to sell agricultural products including livestock to the construction related workforce and project personnel with significant benefit to local farmers in terms of cash economy. The magnitude of impact is considered to be moderate, extent is local and duration is medium term.

9.4.3 National/Regional Economy

The proposed distribution lines will be tied to the national grid, including the new high voltage lines in the transmission component which will deliver up to 2000 MW of new electricity supply capacity in the Central and Western Development Regions of Nepal. The associated hydropower plants under construction now total about 145 MW, which will provide clean energy supplies sufficient for the minimum electricity needs of at least 1,000,000 people, with avoided greenhouse gas (GHG) emissions of 400,000 tons carbon dioxide equivalent per year[115]. Improved power supplies are expected to promote some urbanization in the sub-project corridors as well as support the creation and operation of small-scale industrial development (village and/or micro-scale).

9.5 Mitigation Measures

Table 9.4 summarizes potential impacts and mitigation options. At the design stage, potential impacts are mitigated by careful routing to avoid sensitive ecosystems such as forests and wetlands, steep terrain, and populated areas to the maximum extent possible. In all cases, routing options will be identified at the detailed survey stage, with lines and substations located away from forested areas and potentially sensitive habitats to the maximum extent possible. Tree replacement will be at 25:1. Biodiversity offsets may be considered as a last resort.

9.5.1 Soil Erosion and Loss of Vegetation

The majority of the ROW is expected to be adjacent to or within a few kilometers of existing roads and tracks. Temporary access tracks are not expected to be needed. Soil erosion and silt runoff will be minimal as excavation is required only for pole footings and substation foundations. Erosion control measures such as dikes and retaining walls will be constructed as necessary to ensure pole footings are stable; this will also minimize soil erosion and runoff. Drainage controls will also be included in substation design.

The ROW will be acquired prior to construction and the affected people will be compensated. Clear felling will be limited to 6 m in forested areas. Trimming of vegetation for routine maintenance will be conducted on an annual or as-needed basis after construction. Minor damage to crops may be unavoidable, and any crop damage will be compensated as per the existing rules. The total affected forested area will be determined during line surveys and substation spotting. New trees will be planted to offset those removed during construction. Replanting will be at a ratio of 25:1. Additional offset activities are discussed below in Section 9.5.8.

[115] The assumptions are: (i) new clean energy capacity is 100 MW increasing to 1000 MW, running 4000 hours per year; (ii) electricity consumption of 400 kilowatt-hours per year per person (0.4 MWh/person/year); and (iii) clean energy displaces diesel-fired generation with an emissions factor of 1 ton carbon dioxide equivalent per megawatt-hour.

Table 9.4: Potential Impacts and Mitigation Measures for Overall Project

Parameter	Activity and Potential Impacts	Nature [a]	Magnitude [b]	Extent [c]	Duration [d]	Mitigation Measures
Potential Impact on Physical and Biological Environment: Design and Construction Phases						
Topography, land use, and biota	Clearing of distribution right-of-way (ROW): improved access may increased stress on wildlife and sensitive species; possible increase in poaching	D	M	L	ST	Routing to minimize disturbance of vegetation. Pole height to be increased to allow 1-2 meters of vegetation in areas where wildlife migration pathways are to be preserved / enhanced. Access restrictions to be included in contract specifications and construction plans. Construction contracts to include provisions for worker awareness, anti-poaching, and supply alternate fuels. Clear felling to be limited to 6 meters ROW or less. Reforestation at 25:1 and/or other offset activities as agreed with protected areas management.
	Visual impairment of landscape	D	M	L	LT	Routing to avoid inhabited areas and popular tourist and trekking areas to the extent possible and practical. Use low-visual impact tower and substation design.
Noise and vibration	Construction equipment >70 dB(A) at project site	D	L	SS	ST	Equipment to meet national noise standards; personal protective gear to be provided to construction workers. Restrictions on night-time operations in populated areas
	Noise from distribution lines and associated substations	D	L	SS	ST	Locate substations 70–100 m from nearest receptor if possible; greenbelt to provide partial noise barrier if necessary to limit noise to 55 dB(A) at nearest receptor or 3 dB(A) above background.
Water quality	Soil erosion and wastewater from work sites and construction camps: Suspended solids, BOD, and fecal coliform contamination	D	L	SS	ST	Run-on / run-off control including retention ponds, silt traps, and other treatment if needed Construction staging areas and camps to be located outside of ecologically sensitive areas, except as necessary (e.g., for lines in the KCA and MCA) Recycling and disposal of solid wastes, including composting of biodegradable wastes Primary treatment of domestic wastewater if needed.

Parameter	Activity and Potential Impacts	Nature [a]	Magnitude [b]	Extent [c]	Duration [d]	Mitigation Measures
Waste generation	Wastewater, waste lubricants, and minor fuel spills: Petroleum and detergent contamination	D	L	SS	ST	Construction staging areas and camps to be located outside of ecologically sensitive areas, except as necessary. Recycling and disposal of solid wastes. Composting of biodegradable wastes Primary treatment of domestic wastewater if needed.
Air quality	Construction dust and exhaust gases: increased SPM, NO_2, SO_2 levels at construction sites, and surrounding areas	D	L	SS	ST	Dust control with water sprays. Contractor's equipment to meet national equipment and vehicle emissions standards
Physical and cultural resources	Disturbance of houses, public buildings, and temples	D	L	SS	ST	Avoid at design stage via careful routing of distribution lines and siting of substations. Ensure that minimum setbacks of 1.25 meters from any structure. Any land acquisition and resettlement will be compensated as per the Resettlement and Indigenous Peoples Plan (RIPP).
Potential Impact on Physical and Biological Environment: Operation Phase						
Topography, land use, and biota	Maintaining distribution right-of-way (ROW) – vegetation control	D	L	SS	LT	Allow vegetation to grow to 1-2 meters high in ROW to allow free movement of wildlife in sensitive areas identified in Table 9.2.
Noise and vibration	Noise from distribution lines and associated substations	D	M	SS	LT	Maintain greenbelt and other noise barriers as necessary to limit noise to 55 dB(A) at nearest receptor or 3 dB(A) above background.
Water quality	Domestic wastewater from substations	D	L	SS	LT	Primary treatment of domestic wastewater (septic tanks)

Parameter	Activity and Potential Impacts	Nature [a]	Magnitude [b]	Extent [c]	Duration [d]	Mitigation Measures
Waste generation	Used equipment and domestic solid wastes from substations	D	L	SS	ST	Secure on-site storage, or off-site disposal at licensed facility if necessary. Used equipment may be refurbished and reused at other sites if possible. Scrap metal may be sold into recycling markets. Biodegradable waste to be composted on site. Non-degradable waste disposed off-site at approved facilities.
Air quality	Increased air emissions at substation sites	D	L	SS	ST	Emissions will be limited to routine vehicle traffic in and out of substations.
Physical and cultural resources	No ongoing impacts after construction	IN	L	SS	ST	Local government units will ensure that squatters do not take up residence in ROW or encroach upon substations.
Greenhouse gas emissions	Minor GHG releases to atmosphere from fire suppression equipment. including from equipment using CFCs and halons (e.g. fire suppression systems):	D	L	SS	LT	Specify non-CFC and non-halon equipment; dispose in accordance with GoN standards.

BOD = biochemical oxygen demand, CFC=chlorofluorocarbons, dB(A) = decibel acoustic, KCA = Kanchenjunga Conservation Area, MCA = Manaslu Conservation Area, NEA = Nepal Electricity Authority, NO_2 = nitrogen dioxide, NO_x = nitrogen oxides, PMU = Project Implementation Unit, ROW=right-of-way, SO_2 = sulfur dioxide, SPM = suspended particulate matter.

Notes: [a] Nature: D=direct, IN=indirect, R=reversible, IR=irreversible
[b] Magnitude: H=high, M=medium, L=low
[c] Extent: SS=site-specific, L=local, R=regional
[d] Duration: LT=long-term, MT=medium term, ST=short-term

9.5.1 Soil Erosion and Loss of Vegetation (continued)

Precautionary measures focused on the protection of vegetation and wildlife are essential while working in all of the forest areas, particularly during the construction stages. Unnecessary felling of the trees and use of old trees for firewood by the workforce should be discouraged during the construction. RoW vegetation clearance should be done manually and herbicides will not be used in any case. Trimming of vegetation will be limited to the ROW and temporary access roads, which will be minimized. No vegetation outside the ROW will be disturbed. Cleared vegetation may be taken by community forest users for local use. Forest rehabilitation will be conducted under Ministry of Forests and Soil Conservation procedures for compensation, with 25:1 replanting ratio. The EMP includes monitoring provisions to confirm the replanting activities are documented.

9.5.2 Air and Noise

Air and noise pollution will be avoided by minimizing use of heavy machinery during construction. Construction will generate air and noise emissions for a short duration in predominantly rural locations, and is considered insignificant. Construction contractors will be required to deploy equipment which meets Nepali air and noise control standards. Construction will occur primarily during daytime hours for safety considerations.

9.5.3 Waste Management

Any used equipment and other construction wastes will be disposed of following the best practices and the local rules. Health hazards from potential explosions or fire, electric shocks, and accidents to staff and the public will be minimized through implementation of measures including (i) designs using appropriate technologies to minimize hazards, (ii) safety awareness raising for construction and operational staff and the public, (iii) substations equipped with modern fire control systems, (iv) provision of adequate water supply and sanitation facilities for substations and construction camps, (v) provision of adequate staff training in operations and maintenance, and (vi) security fences and barriers around substations and distribution poles in populated areas and in the proximity of public places such as schools.

9.5.4 Mitigation at Substation Sites

The new substations will be located on unused land or agricultural land, which will be cleared of crops prior to construction. Substation construction will require some earthmoving to prepare the sites for buildings and equipment installation. Erosion control measures will be incorporated into substation design in accordance with site conditions. Run-on and run-off controls will be built-in to maintain integrity of building and equipment foundations, and avoid run-off of potentially contaminated water.

Air and noise pollution will be avoided by minimizing use of heavy machinery during construction. Temporary nuisance to the residents and pedestrians during movement of the equipment and materials for substation components such as transformers may be unavoidable, and will be minimized by informing affected people in advance of construction, and requiring contractors to implement noise abatement measures. Construction activities will be restricted during the nighttime.

Due to the relatively small area required for the substations, the impact on air quality will be limited and localized. Water sprays will be used as necessary for dust suppression. Contractors' equipment will be required to meet Nepal air and noise control standards.

9.5.5 Flora and Fauna

A ban on poaching of birds and animals in the areas adjacent to the distribution ROW will be enforced during construction.[212] Kerosene or other alternate fuels will be provided to construction camps so that workers will not need to gather wood for cooking. Construction contractors will provide information briefings to the workforce as well as regular spot checks to enforce restrictions on poaching and gathering of firewood. The construction work in community forest areas will be coordinated through DFO and CFUGS, respectively.

As discussed in Section 4, regional mapping by IUCN and ICIMOD indicates that potentially endangered species may be found over large portions of Nepal. Construction may be restricted during breeding and migration seasons, if warranted. The EMP includes provision for reforestation to offset potential impacts on sensitive ecosystems. There are various programs and projects being implemented in Nepal which will partially offset potential impacts on sensitive species including those in the ACA; these programs are discussed below (IEE Volume 2, Section 5.5.8) and summarized in Appendix 3.

9.5.6 Monitoring and Oversight

Monitoring and oversight are included in the EMP, which is discussed in Section 11. Construction contractors will prepare and implement environmental, health, and safety plans. Implementation consultants will conduct periodic inspections of construction sites and will conduct air, noise, and waste monitoring as necessary.

9.5.7 Greenhouse Gas Emissions Scenarios

GHG emissions scenarios are discussed in the context of cumulative and induced impacts in Section 5.6 of Volume 2. Net GHG emissions resulting from the project are expected to be negative as the distribution lines will connect major new clean energy sources to the grid, offsetting the use of traditional biomass and diesel- or gasoline-fired generators.

9.5.8 Offset of Potential Impacts in Sensitive Habitats

The EMP includes revegetation and reforestation to offset potential impacts related to clearing and maintaining ROW (the EMP is presented in Section 11). Based on the reconnaissance visits, available data, and assessment conducted to date, the project will not impinge directly on critical or natural habitats, except for those subprojects identified in Table 9.2. Biodiversity offset specific to flora and fauna in the KCA, buffer zone of Langtang National Park, and the MCA, may be considered as a last option; the need for such an offset will be determined based on further assessment conducted during the survey stage.

A generic offset will be achieved through tree replacement at a ratio of 25 new trees for each tree removed (25:1). Wildlife movement can be facilitated by allowing vegetation to grow to a height of 1-2 meters in the ROW; this may require increasing distribution tower height in some instances (see Table 9.2 above). The project will result in increased clean energy supplies and increased access to energy, which will reduce pressure on forests for fuelwood.

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[212] In other parts of Nepal, hunting and poaching does not appear to be a major issue. For example, the EIA summary for the Tamakoshi 3 hydropower project noted that hunting and poaching is not common and no obvious signs of such activity were observed during the EIA surveys; hunting is banned in the community forests. SWECO Norge AS. 2009. *Tamakoshi 3 Hydroelectricity Project, Executive Summary – Volume XI, Document for Disclosure, Final Report – November 30, 2009*. Oslo, Norway.

The National Rural Renewable Energy Program (NRREP) led by the Nepal Alternative Energy Promotion Center (AEPC) is implementing a broader clean energy program targeting areas with reliance on fuelwood and other traditional biomass. The RE-based mini grid component cofinanced by the Scaling Up Renewable Energy Program (SREP) has been developed under the aegis of the NRREP. Also under the NRREP and the SREP Investment Plan for Nepal, ADB's Private Sector Operations Department is developing a small hydropower investment program which is expected to be approved by ADB's Board in 2014. Various other hydropower projects are under development by the private sector. The status of compliance with relevant provisions of ADB environment safeguards is summarized in Table 9.5].

Table 9.5: Compliance with ADB requirements for Sensitive Habitats

ADB Safeguard Provision [a]	Degree of Impact
Critical Habitats Do not implement project activities unless: (i) There are no measurable adverse impacts on the critical habitat that could impair its ability to function (ii) There is no reduction in the population of any recognized endangered or critically endangered species (iii) Any lesser impacts are mitigated	Review of habitat maps and ranges indicate that the project facilities and right-of-way will have minimal or no direct impact on critical habitats. This finding will be updated during detailed survey stage. Small size of individual sub-project "footprint" will result in no quantifiable adverse impacts on sensitive species in the project area. Potential impacts due to clearing of vegetation will be offset by reforestation activities included in the EMP, and other offsetting activities.
Legally Protected Areas Implement additional programs to promote and enhance the conservation aims of the protected area.	Locations of the distribution subprojects with respect to legally protected areas to be determined at detailed survey stage; mitigation measures to be identified accordingly.
Natural Habitats There must be no significant conversion or degradation, unless: (i) Alternatives are not available (ii) The overall benefits of the project substantially outweigh the environmental costs (iii) Any conversion or degradation is appropriately mitigated	The project facilities and right-of-way will impinge on natural habitats, but the area is limited to less than 150 hectares of forested land. There are no viable alternatives to the project based on technical, environmental, economic, and social considerations. Potential environmental costs of the project are minimal and will be offset by reforestation, benefits of the project, and benefits accruing from various other ecological preservation activities.
Notes: [a] ADB *Safeguard Policy Statement 2009*, page 16, Environmental Safeguards, Policy Principle number 8.	

Ongoing Activities Which Indirectly Offset Impacts of the Project

There are numerous donor-funded activities in Nepal promoting and supporting protected areas and forest management, preservation of biodiversity and cultural diversity, capacity building for adaptation to climate change and for climate resilient development, community-scale renewable energy development, institutional

development for reducing emissions from deforestation and degradation (REDD+), and capacity building for payment for ecosystems services (PES). Donor agencies, special funds, and other partners include ADB, the European Union, the Global Environment Facility (GEF), IUCN, the Pilot Program for Climate Resilience (PPCR), the program for Scaling Up Renewable Energy Program in Low-income Countries (SREP), and several bilateral programs (Finland, Germany, Japan, Norway, United Kingdom, and the United States). See Appendix 3 for further information on off-setting activities.

9.6 Cumulative and Induced Impacts

Suppressed power demand due to economic growth is inducing the Project rather than *vice versa*. Consumers rely on traditional biomass, and/or expensive diesel and gasoline (petrol) generators for back-up power, and new distribution capacity is necessary to alleviate the power demand-supply imbalance. The direct impacts are minimal, as discussed above. Various hydropower plants that will be connected to the new transmission lines are associated facilities and are discussed in section 5 of Volume 2 (see Table 3.3). The distribution subprojects are all "downstream" of the associated hydropower plants and the new transmission lines, and are integral to the overall Project.

New small and micro-enterprises are expected to develop as a result of improved electricity supplies. E.g., cafes, markets, agro-processing, internet and computer service shops, and woodworking (carpentry). Such enterprises may be considered as "associated facilities." Schools and health clinics will also benefit from improved electricity supplies. The cumulative impacts from economic development will ultimately depend on implementation of rational zoning and land use management, solid waste management, wastewater treatment, and sustainable transport systems.

10. Information Disclosure, Consultation, and Participation

10.1 Information Disclosure

The initial draft of this IEE which included only the transmission component was disclosed on ADB's website February 2014. The revised draft including this volume will be posted prior to ADB Board consideration.

10.2 Consultation and Participation

The citizens of Nepal are painfully aware of the need for additional electric power investments. About 44% of the population has no access to electricity and a majority of the population still relies on traditional biomass for energy needs. Load shedding of 12 hours per day or more directly impacts consumers who are connected to the electricity grid. Power shortages have grown more severe during the past several years, a fact which is widely known throughout the country. In effect, it is highly unlikely that people who are potentially affected by the project are not aware of the poor state of commercial energy services in Nepal in general and in the project area in particular.

NEA conducts informal consultations as part of its route surveys, and formal consultation during preparation of environmental assessments (IEEs and EIAs) for transmission lines. As discussed in section 6 (Volume 2), extensive consultation has been conducted in selected areas for transmission lines, some of which cover the distribution subprojects. Due to the large number of distribution subprojects, and the fact that specific line routes and substation sites have yet to be identified, the consultations were conducted on a sample set of subprojects.

The surveys being conducted for land acquisition and resettlement planning include consultation with directly affected people; the main environmental and social impacts arise from ROW clearing and substation construction, and social surveys therefore serve the purposed of consultation on potential environmental impacts. Documentation of these surveys is included in Appendix 5.

The various hydropower projects in the transmission corridors are also required to conduct stakeholder outreach and consultation: it is possible that some potentially affected people will have been informed on more than 2 occasions about the power system expansion projects prior to construction of the distribution system components. Residents in the project areas are familiar with the need for distribution system expansion and other infrastructure, and generally support the proposed project components.

As discussed above, the exact routing of lines and locations of substations will be determined during pre-construction surveys. For subprojects which may be located in protected areas, NEA will consult with the relevant authorities to confirm that distribution systems are consistent with protected area management plans.

10.3 Grievance Redress Mechanism

NEA has an existing procedure to receive inquiries and complaints about project related activities (developed for other ADB projects), as well as responding to such inquiries and complaints. Feedback from potentially affected people will be used to establish a grievance redress mechanism (GRM) appropriate to the expected level of impacts.

The ADB *Safeguard Policy Statement 2009*, Appendix 1, paragraph 20, clearly notes that GRM is the responsibility of the borrower:

> The borrower/client will establish a mechanism to receive and facilitate

> resolution of affected people's concerns, complaints, and grievances about the project's environmental performance. The grievance mechanism should be scaled to the risks and adverse impacts of the project. It should address affected people's concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people at no costs and without retribution. The mechanism should not impede access to the country's judicial or administrative remedies. The affected people will be appropriately informed about the mechanism.

In the context of the proposed Project, there are potential language and other communication barriers. Potentially affected people may have mobile phones, radios, and televisions, but may not have ready access to internet.

Consultation of potentially affected people is still being undertaken for the Project, and there is a need for a sustained effort to address any concerns and complaints. The general information flow for registering and responding to concerns and complaints is illustrated in Figure 10.1. During construction, concerns and complaints would be brought to the attention of the construction contractors, project implementation services consultants, PMU, NEA, Ministry of Finance, and ultimately to ADB if necessary. During operations, concerns and complaints shall initially be brought to the attention of NEA representatives in project area.

The GRM for the project is outlined below and consists of four levels with time-bound schedules and specific persons to address grievances.

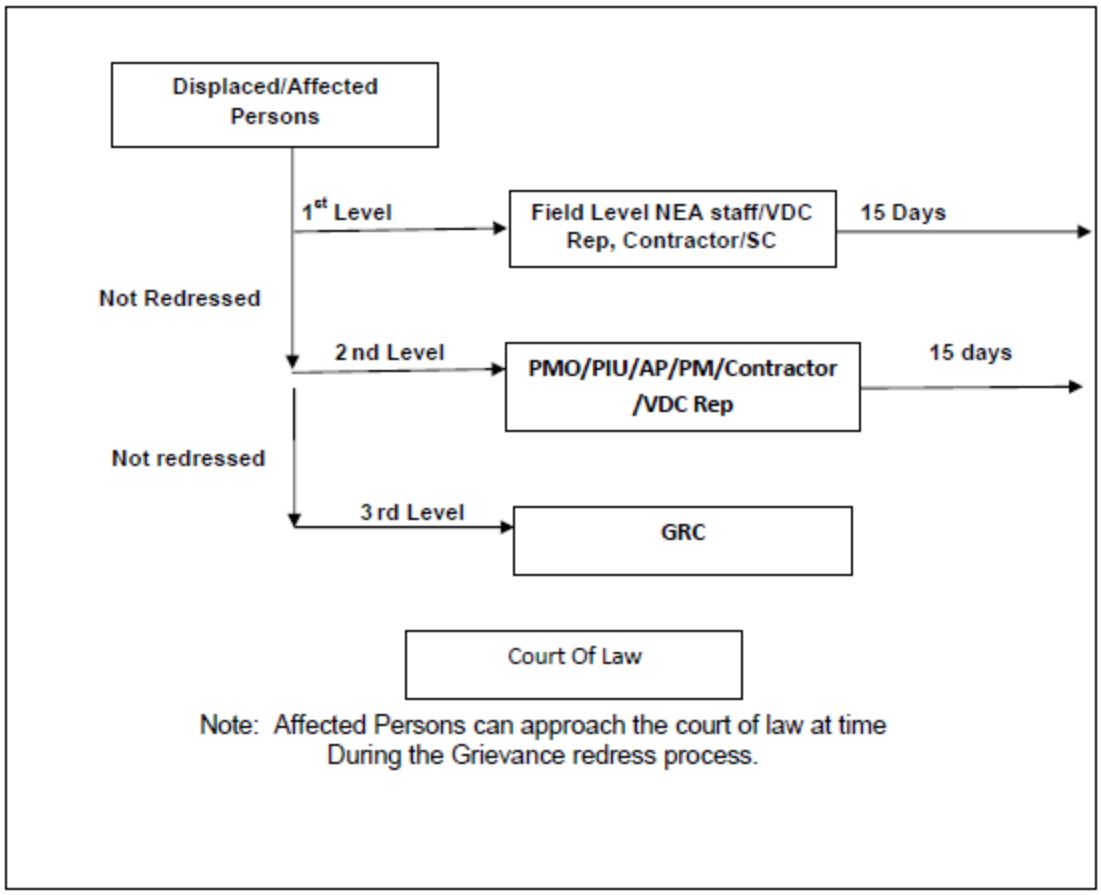
1. First Level of GRM

The first level and most accessible and immediate venue for the fastest resolve of grievances will be the site official. If any complaints arise, the NEA site engineer/official, the construction contractors and project supervision consultant (SC) with the assistance of VDC representatives will immediately resolve the complaint on site. Any person with a grievance related to the project works can contact the SC to file a complaint. The SC will document the complaint, and immediately address and resolve the issue at field-level with the construction contractor, representatives of the respected VDC and the affected persons within 7 days of receipt of a complain/grievances. The SC will fully document the following information: (i) name of the person, (ii) date of complaint received, (iii) nature of complaint, (iv) location of complaint, and (v) how the complaint was resolved. If the complaint remains unresolved at the field level, the SC will forward the complaint to NEA's Project Manager Office (PMO) headed by the project manager at Project Implementation Unit (PIU). This is a site office of NEA who is responsible for site level implementation activities.

2. Second Level of GRM

If the grievance remained unresolved, the person filing the grievance will be notified by the SC that the grievance was forwarded to the PMO at PIU. PMO with the support of SC Social Expert, construction Contractor will try to resolve the grievances through continuous interactions with the affected persons within 15 days of complaints forwarded by SC.

Figure 10.1: Grievance Redress Mechanism



Source : Resettlement and Indigenous Peoples Plan

3. Third Level of GRM

If the grievance remains unresolved PMO, Chief District Officer (CDO) of the district will activate the third level of the GRM by referring the issue (with written documentation). A Grievance Redress Committee (GRC) will be formed. The GRC will consist of members of the PMO, affected persons, VDC, SC Social Expert and a third party Non Government Organization (NGO). A hearing will be called with the GRC, if necessary, where the affected person can present his/her concern/issues. The GRC will suggest corrective measures at the field level and assign clear responsibilities for implementing its decision within 15 days. The functions of the local GRC are as follows: (i) provide support to affected persons on problems arising from environmental or social disruption; asset acquisition (if necessary); and eligibility for entitlements, compensation and assistance; (ii) record grievances of affected persons, categorize and prioritize them and provide solutions within 15 days; and (iii) report to the aggrieved parties about developments regarding their grievances and decisions of the GRC. The consultant social expert will be responsible for processing and placing all papers before the GRC, recording decisions, issuing minutes of the meetings and taking follow up action to see that formal orders are issued and the decisions carried out.

4. Court Of Law/ Country's Legal System

The proposed mechanism does not impede access to the country's judicial or administrative remedies. The AP has the right to refer the grievances to appropriate courts of law if not satisfied with the redress at any stage of the process or the APs will have the choice to approach country's judicial system. The PIU will keep records of all grievances received including: contact details of complainant, date that the complaint was received, nature of grievance, agreed corrective actions and the date these were effected, and final outcome.

11. Environmental Management Program

Key issues to be addressed by the EMP are :

- Clearance of ROW: determination of potential impacts on sensitive habitats and potentialy endangered species; and advance notice to affected communities
- Cleared vegetation can be utilized by Community Forest User Groups (CFUGs); however, no burning of vegetation in construction areas is allowed
- Construction schedule may be restricted if deemed necessary during migration season of sensitive species
- Construction contractors will implement corporate EH & S programs
- Implementation consultants will support monitoring and inspection activities, with support from other third-party service providers as necessary
- Provisions for reforestation are included to offset clearing of vegetation in the distribution ROW

The EMP has been developed as part of the environmental assessment to avoid, minimize, and mitigate potential negative impacts of the Project. The EMP comprises routine environmental monitoring to support proactive mitigation of any potential impacts from construction and operations. The EMP includes the following:

(vi) proposed management, mitigation, and monitoring activities (Tables 11.1 and 11.2)
(vii) description of responsibilities and authorities for mitigation and monitoring, reporting, and review
(viii) preliminary work program (Table 11.3), and
(ix) preliminary cost estimates (Table 11.4).

11.1 Proposed Management and Mitigation Measures

The purpose of the EMP is to guide the pre-construction, construction, and operational periods of the project as per Nepali and ADB environmental requirements. The EMP will be updated during the project design and implementation stages as necessary based on field conditions, construction contractor performance, and stakeholder feedback.

Table 11.1 presents the EMP for the overall project, covering 3 stages: (i) Pre-construction, (ii) construction, and (iii) operations and maintenance. The EMP is dynamic and will be updated and modified as necessary and appropriate based on contractor performance and monitoring results. Modifications to the EMP will be made by the NEA PMU and included in the twice-yearly progress reports submitted to ADB, or more frequently if necessary. Compensatory afforestation and reforestation is possibly the most significant activity of the EMP. After the detailed route surveys are completed, a Compensatory Planting Plan and Slope Stabilization Plan will be prepared in consultation with the Ministry of Forest and Soil Conservation and relevant District Forest Office. Criteria for afforestation and reforestation should be defined in terms of retaining and improving biodiversity and ecosystem connectivity. As discussed above in Section 9, special attention should be paid to the subprojects located in or near IBAs, KCA, buffer zone of Langtang National Park, and MCA so that mitigation efforts complement on-going biodiversity conservation activities in those areas.

During the construction stage, the EMPs for the individual projects are the most important documents for use by NEA, project implementation consultants, and construction contractors. The EMP summarized in Table 11.1 is by necessity preliminary in nature, and is intended to guide project implementation. The EMP will be updated by the project preparation services consultants[117] as the site surveys are conducted and the actual subproject locations are finalized. NEA has commissioned or will commission IEE and/or EIAs for individual transmission lines and the findings from these assessment which are in the same general area as distribution subprojects will also guide the EMP update and implementation.

11.2 Proposed Monitoring Plan

Distribution systems and including substations do not emit conventional pollutants, except for emissions from construction activities, used equipment and materials, and domestic wastes from substations. The associated hydropower plants are all run of river design with minimal storage capacity. Potential methane emissions will be non-existent or minimal compared to storage-type designs. Potential spills of fuel, lubricating oils, and transformer oils would be localized at substation sites and unlikely to result in detectable pollution of surface waters. Such spills can be avoided through good housekeeping and safe work practices, and can be readily mitigated by containing visibly contaminated soils and other waste materials on-site in drums or other secure containers. The potential impact of such spills would be localized and of such small magnitude that quantification of impacts is not readily feasible. Therefore, visual inspections are proposed as the main monitoring approach rather than a quantitative analytical approach for conventional pollutant monitoring.

Table 11.2 includes minimum recommended provisions for environmental monitoring. Monitoring activities may be modified during implementation depending on contractor performance and analytical results. If field inspections, monitoring, and analyses indicate good environmental performance, then successive monitoring intensity and frequency may be reduced. Conversely, if environmental performance is worse than expected, corrective measures will be identified and monitoring activities will be adjusted accordingly to resolve any problems.

11.3 Work Program

The preliminary work program for the first 3 years of implementation is summarized in Table 11.3. EMP related work will begin in early 2014. Procurement support will begin by mid-2104 and design review activity will begin in fourth quarter of 2014. Construction is not expected to commence until 2015 at the earliest. Any additional baseline and other survey and assessment work that may be required can be completed before construction commences. Clearing of vegetation and re-vegetation/reforestation activities are expected to be conducted outside of the monsoon season, pending recommendations of the IEEs and EIA for individual distribution lines.

[117] Consulting services will be retained under ADB TA8412-NEP. Consultants will be mobilized in the 3rd quarter of 2014.

Table 11.1: Preliminary Environmental Management Plan

Project Activity	Environmental Issues	Management, Mitigation, and Monitoring Activities	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Pre-construction Phase				
Regulatory clearance and permitting	Impact on potentially sensitive ecosystems: potential loss of productive agriculture and forest products, and potential loss of habitat and ecological value	Letter from National Planning Commission to indicate if the ADB-funded activities comprise a National Priority Project. Permitting for clearance of Right-of-way (ROW) prior to construction: (i) Advance notice and no objection from residents; (ii) Compensation arrangements for loss of cash crops (10-year valuation on fruit trees; current market value for timber and other crops); (iii) Permissions and letter agreements from relevant District Forest Office, Community Forest User Groups (CFUGs), and if necessary from Department of National Parks and Wildlife Conservation; and (iv) Prepare Compensatory Planting Plan and Slope Stabilization Plan with Ministry of Forest and Soil Conservation and District Forest Office. ROW demarcation and detailed survey: (i) Delineate ROW via survey; (ii) Consultation with potentially affected residents and CFUGs within 1 kilometer of ROW; (iii) Marking of trees to be cut, avoiding areas where “hollows” provide living space for sensitive wildlife; and (iv) Confirm locations for compensatory planting at least one month before commencing the construction work. NEA to commission surveys for individual lines and substations in advance of contract tendering from Q3 2014 onwards. Surveys will identify protected areas and any other sensitive ecosystems, with ROW adjusted to avoid such areas to the maximum extent possible. NEA to consult with protected areas management teams as soon as possible and obtain No Objection document(s) prior to contract tendering.	NEA / PMU to obtain letter, if necessary, from National Planning Commission NEA / PMU in consultation with Ministry of Forest and Soil Conservation, District Forest Offices, Department of National Parks and Wildlife Conservation District Forest Office to provide confirmation of tree marking and proposed compensatory planting areas IEE to be updated by consultants under ADB TA 8412-NEP	“No objection” from ADB prior to contract tender and awards Protected areas management chiefs to issue No Objection Certificate as necessary for subprojects in KCA, buffer zone of Langtang National Park, and MCA

Table 11.1: Preliminary Environmental Management Plan (continued)

Project Activity	Environmental Issues	Management, Mitigation, and Monitoring Activities	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Pre-construction Phase (continued)				
Distribution design and construction plan: (i) Selection of construction staging areas, equipment maintenance, waste management procedures, and access controls; (ii) Baseline monitoring	Components in IBAs, KCA, buffer zone of Langtang National Park, MCA, and any other ecologically sensitive areas Potential pollution from air, noise, and hazardous materials during construction and operations Safety during construction and operations	Distribution poles and lines to include high-visibility markers such as bird flight diverters in environmentally sensitive areas. Include adequate erosion control for pole footings in steep terrain. Increase pole height if necessary to allow for 1-2 meter revegetation beneath lines. Route lines around cultural heritage sites. Ensure adequate setbacks from inhabited areas for substations and other facilities as necessary. Construction equipment to meet national air and noise emissions standards. Construction contract to include provision for waste management including possible industrial hazardous wastes. Contractors to prepare and implement corporate EHS plan. Contractors to have established corporate environmental, health, and safety (EHS) program; ISO 14001 certification or equivalent is desired. Prior to clearing of ROW and other construction activities, conduct visual monitoring with photodocumentation	NEA / Design team Project Preparation Services Consultants (TA 8412-NEP) [or ESSD] to conduct monitoring with third party services as necessary	"No objection" from ADB prior to contract tender and awards
Qualification and selection of construction contractors	Environmental, health, and safety performance of construction contractors	Construction contracts to include provisions for corporate EHS program and/or ISO 14001. Special conditions of contract may include incentives and penalties for inadequate environmental performance.	NEA / PMU to include appropriate provisions in bidding documents and contracts	

Table 11.1: Preliminary Environmental Management Plan (continued)

Project Activity	Environmental Issues	Management, Mitigation, and Monitoring Activities	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Construction Phase				
Physical construction: manual labor and mechanized construction	Worker / operator safety (noise, vibration) Equipment wear and tear Traffic management	Construction techniques and machinery selection to minimize noise and vibration. Noise to be limited to 55 dB(A) at site boundaries or 3 dB(A) above background. Construction equipment to be maintained in accordance with national standards for noise exposure to workers. Water sprays will be used to control dust as necessary. Construction contractors to monitor for dust, noise, and vibration in the event of any complaints from workers or communities Results to be included in semi-annual Safeguards Monitoring Report. Any required road improvements will include drainage and erosion control measures and will be designed to minimize disturbance to normal traffic flows.	Construction Contractors will implement corporate EHS plan. Project preparation services consultants (TA8412-NEP) and/or Project Implementation Consultants (or ESSD) to conduct monitoring and inspections utilizing 3rd-party services as necessary	PMU to conduct periodic spot checks to confirm compliance. ADB review Missions
Health and safety	Injury and sickness of workers and members of the public Potential BOD and fecal coliform contamination	Construction camps to be located outside of sensitive ecosystem areas. Any camps will include proper sanitation, water supply, and waste disposal facilities, including primary treatment for domestic sewage and secure disposal of domestic solid wastes. Contractor to prepare and implement a health and safety plan including worker training, daily/weekly briefings, and spot checks at work sites. Contractors to give “tool box” talks on environmental issues and to enforce anti-poaching and other environmental protection provisions.		
Construction equipment maintenance	Wastewater from maintenance may cause soil and water contamination	Construction equipment staging and maintenance areas to be located outside of environmentally sensitive areas. Construction contractor to provide wastewater containment, and sedimentation and biological treatment, if necessary.		

Table 11.1: Preliminary Environmental Management Plan (continued)

Project Activity	Environmental Issues	Management, Mitigation, and Monitoring Activities	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Construction Phase (continued)				
Ambient air quality and noise nuisance	Dust, exhaust, and noise emissions from construction equipment	Controlled construction activities and maintenance of machinery, timely scheduling of construction activities to avoid nuisance to sensitive ecosystems (and nearby communities). Construction equipment to meet national emissions and noise control standards. Water sprays to be used for dust control as necessary.	Construction contractors to implement EHS plan Project preparation services consultants (TA8412-NEP) and/or Project Implementation Consultants (or ESSD) to conduct monitoring and routine inspections	NEA / PMU ADB review missions
Storage of chemicals and any hazardous materials	Possible spills resulting in contamination of soil, water, and air	Fuel, lubricants, and any other hazardous materials will be staged outside of protected areas to the maximum extent possible, and will be securely stored to prevent spills. Contractors to provide spill response kit in accordance with Material Safety Data Sheets for chemicals and hazardous materials		
Construction waste management	Air, soil, and water pollution due to inadequate management and control	Construction wastes to be managed in accordance with national standards and best practices. Soil, rock, and other spoils to be used in run-off control structures to maximum extent practical. Waste lubricating oils to be disposed or recycled off-site by licensed service companies. Contractors' EHS plans to include contingency provisions for testing of polychlorinated biphenyls (PCBs) if any transformers are to be decommissioned; if necessary, arrange for secure storage at substation sites or controlled off-site disposal at licensed facilities.		

Table 11.1: Preliminary Environmental Management Plan (continued)

Project Activity	Environmental Issues	Management, Mitigation, and Monitoring Activities	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Construction Phase (continued)				
Construction stage environmental monitoring	Inadequate/unsafe working conditions Environmental impairment at protected areas and other project sites	Appropriate contact clauses to ensure satisfactory implementation of contractual environmental, health, and safety measures. Implementation of environmental monitoring and reporting system using checklist of all contractual environmental requirements.	PMU and project preparation services consultants (TA8412-NEP) and Project Implementation Consultants (or ESSD)	NEA, ADB NEA / PMU
Biodiversity protection and improvement	Preservation of sensitive habitats	Clearing of vegetation in distribution ROW should be minimized, e.g., cutting vegetation low to ground while preserving root structure rather than complete removal. Distribution poles and lines to include high-visibility markers such as bird flight diverters in environmentally sensitive areas. Reforestation as per Nepali and ADB requirements: implement Compensatory Planting Plan and Slope Stabilization Plan with Ministry of Forest and Soil Conservation and District Forest Office. Update list of offsetting activities on an annual basis.	Project preparation services consultants (TA8412-NEP) and Project Implementation Consultants (or ESSD)	NEA / Ministry of Forest and Soil Conservation ADB

Table 11.1: Preliminary Environmental Management Plan (continued)

Project Activity	Environmental Issues	Management, Mitigation, and Monitoring Activities	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Operation and Maintenance Phase				
Routine operations and maintenance	Potential loss of vegetation and habitat in protected areas	Maintain warning / advisory signs in good condition Visual inspection of annual vegetation trimming in distribution right-of-way	PMU and Project Implementation Consultants (or ESSD)	NEA, Ministry of Environment ADB Review Missions
Periodic air, noise, and water quality monitoring at sensitive areas	Maintain EHS program to prevent pollutant emissions via source controls	Monitoring results to be reviewed by NEA and ADB to confirm that mitigation measures are adequately controlling pollution at the source and preventing ecosystem deterioration. Pollutant source monitoring parameters and frequency may be modified if results show no degradation. Evidence of degradation would trigger operational review to determine need for improved control measures.	PMU and Project Implementation Consultants (or ESSD)	NEA ADB Review Missions
Biodiversity protection and improvement	Preserve and improve ecosystem integrity	Biodiversity offset management and annual habitat / biodiversity surveys to be conducted if deemed necessary.		

Table 11.2: Minimum Provisions for Environmental Monitoring

Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
Pre-construction Stage				
Dust and Noise	Up to 5 locations around project area to be identified by NEA / ESSD	Spot check for noise and dust using portable monitoring devices	Noise monitoring: at least 1 event prior to start of construction.	PMU supported by Implementation Consultants and other third-party services NEA / PMU to include EMP in bidding documents; ADB to verify requirements in bidding documents.
Construction Stage				
Clearing / cutting vegetation and offsetting areas for afforestation and reforestion	Forested areas of ROW and afforestation / reforestation sites	Field inspection of vegetation clearing and reforestation to ensure that appropriate measures are implemented	Vegetation clearing and reforestation: quarterly during construction period	Contractors to implement corporate EHS plan, including wastewater and solid waste control. EMP Implementation consultants to conduct pollutant source emissions monitoring, and inspect wastewater and solid waste controls. PMU staff to provide oversight via regular field inspections, and submit semi-annual Safeguards Monitoring Report. ADB to audit during project review missions.
Dust and Noise	5 stations around project area (same as during construction)	Spot check for noise and dust using portable monitoring device	Dust and noise: quarterly during construction period	
<u>Construction wastes:</u> on-site inspection	Visual inspection of active construction areas, including equipment staging areas and camps	Spot check / visual inspection of solid waste generation and disposal. Analysis of transformer oils to determine if polychlorinated biphenyls are present.	Monthly spot checks for construction waste management	

Table 11.2: Minimum Provisions for Environmental Monitoring (continued)

Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
Operations and Maintenance Stage				
Reforestation monitoring	Reforestation sites agreed with NEA and other stakeholders	Spot checks based on visual inspections and any complaints	Twice-yearly surveys	NEA / PMU ADB to audit during project review missions

ADB = Asian Development Bank, BOD = biochemical oxygen demand, DO = dissolved oxygen, ESSD = Environment and Social Services Department of NEA, NEA = Nepal Electricity Authority, PMU = project Implementation unit, SPM = suspended particulate matter, TSS = total suspended solids

Table 11.3: EMP Work Plan – Key Activities

Activity	2014		2015				2016				2017	
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Surveys and Site Selection for Individual Lines and Substations												
Identify protected areas and sensitive ecosystems & adjust ROW and substation sites to avoid these areas	X	X	X	X								
Monitoring Activities												
Visual inspections beginning with contractor mobilization – Quarterly or monthly or more frequently by PMU / ESSD / PPS and PIC consultants	X	X	X	X	X	X	X	X	X	X		
Quantification of tree removal and other vegetation removal (outside of monsoon season); PMU / ESSD quarterly inspections and bi-annual monitoring reports		X	X	X		X	X	X				
Reforestation / Offset Program												
Afforestation / Reforestation / Other offset activities (outside of monsoon season)		X	X	X		X	X	X		X	X	X
Quarterly disbursements and twice-yearly monitoring reports	X	X	X	X		X	X	X				

ESSD = Environmental and Social Safeguards Department of NEA, NEA = Nepali Electricity Authority, PIC = project implementation consultants, PMU = project implementation unit of NEA, PPS = project preparation services (under TA8412-NEP)

11.4 Responsibilities for Mitigation, Monitoring, Reporting, and Review

NEA/PMU

The existing Project Coordination Office will be upgraded to a Project Management Unit (PMU) within a Project Management Directorate (PMD) at NEA. The PMU includes officers responsible for environmental and social safeguards implementation. The PMU is responsible for the ongoing ADB-funded projects covering distribution system expansion and upgrade, energy efficiency and renewable energy development.

The PMU will ensure that bidding documents include criteria for EHS policy and environmental certification criteria as noted. Special conditions of contract may include penalties and incentives for environmental performance. The PMU will prepare monitoring reports 2 times per year and submit these reports to ADB. The PMU will prepare environmental management reports every 6 months during construction and annually through the first year of operations. The reports will cover EMP implementation with attention to compliance and any needed corrective actions. Additional public consultation will be conducted as necessary during construction. The PMU is in the process of updating its website to provide for public disclosure and public comments.

NEA will have primary responsibility for updating the IEE as per ADB and Nepali regulatory requirements and for implementing the EMP, with support from Project Preparation Services (PPS) consultants retained under ADB TA 8412-NEP and project implementation consultants (PIC) funded by the project. NEA will engage ESSD and/or other third-party firm as necessary for overall project implementation activities. ESSD will conduct routine inspections of construction activities, including visual survey of ROW clearance, construction equipment staging areas, and construction camps. ESSD will take initial responsibility for the ambient environmental monitoring, including procurement and delivery of monitoring equipment, and conducting routine emissions monitoring during construction and operations. The scope of work is outlined below:

(iv) Review construction contractors EHS plan, and recommended revisions as necessary;
(v) Conduct environmental monitoring and analyses (air, dust, noise, vibration, and water quality) twice yearly and at least once prior to commencement of construction; conduct visual inspections of construction areas at least twice yearly and more frequently if deemed necessary;
(vi) Assist PMU in preparation and delivery of Safeguards Monitoring Report two times per year.

Construction Contractors

Construction contractors will be required to have a corporate environmental, health, and safety (EHS) policy, and environmental management certifications such as ISO 14001 (or equivalent). Contractors will have primary responsibility for worker health and safety at construction sites and camps. This includes provision of appropriate personal protective equipment (e.g., hard hats, safety boots, and hearing protection), provision of sanitation facilities, and controlled management and disposal of construction, domestic, and sanitary waste facilities.

Asian Development Bank

ADB will (i) review and endorse the IEE and EMP before contracts are finalized and construction commences; (ii) review monitoring reports; and (iii) officially disclose environmental safeguards documents on its Web site as necessary in accordance with the ADB *Public Communications Policy* (2005).

11.5 EMP Cost Estimates

Preliminary cost estimates for the EMP are shown in Table 11.4; all estimates are subject to revision. The major costs are for basic monitoring activities over a 3-year implementation period. Costs for revegetation / reforestation will be estimated during the detailed survey stage. in the IEEs and EIA for individual distribution lines. The basic EMP cost will be funded by the Project or from government counterpart funds, except for updating the IEE, which would be funded by ADB TA8412-NEP.

Table 11.4: Preliminary EMP Cost Estimates (to be revised)

Activity	Unit	Unit Cost ($)	Total ($)
Contractor EHS Review by Implementation consultants	LS	10,000	10,000
IEE Update – International Consultant	2 p-m	20,000	40,000
IEE Update – International Consultant Travel 1 RT airfare @ $5000/RT; 20 days per diem/year @ $150/day = $3000; + miscellaneous costs = $500	LS	8,500	8,500
Implementation Consultants – International expert for field monitoring [assumes 2 visits per year, 2 p-m per year x 3 years]	6 p-m	20,000	120,000
Implementation Consultants – International Travel 2 RT airfare/year @ $5000/RT; 60 days per diem/year @ $150/day; + miscellaneous costs = $500 per trip; subtotal =	LS / year	20,000	60,000
National consultants for Implementation Remuneration for Monitoring and Visual Inspections (1 full-time equivalent, 3 years)	36 p-m	3,000	108,000
National Consultants – Travel and per diem (local travel @ 250 / month x 36 months = $9000; local per diem 600 days total @ $50 / day = $30,000; plus miscellaneous costs = $1000)	LS	40,000	40,000
Subtotal			***386,500***
Contingencies	LS	38,500	38,500
TOTAL			**425,000**

Source: TA 8272-NEP consultant estimates.

11.6 Additional Assessment and IEE/EMP Update

As discussed above, the EMP is a dynamic document and will be updated going forward. Of particular importance are the detailed surveys for the individual distribution subprojects, which are required to determine the degree of potential impacts on environmentally sensitive areas. NEA will have overall responsibility for ensuring that these surveys are completed in a timely manner, and that the IEE and EMP are updated accordingly. ADB will retain its supervisory role as discussed above.

12. Conclusions and Recommandations

12.1 Key Findings

The proposed Project comprises clearing of right-of-way, construction of new distribution lines and substations, and reinforcement of existing distribution systems. Disturbance during construction will arise from clearing of vegetation, equipment staging, construction of substations, erection of distribution poles, and stringing of conductors on the poles.

The Project has potential environmental sensitivity as some of the distribution lines and substations may be located in or adjacent to environmentally sensitive areas including some IBAs, the KCA, the buffer zone of Langtang National Park, and the MCA. The potential footprint is less than 0.0XX% of the total area of these protected areas. The potential impacts of the project on these areas will be difficult if not impossible to monitor in a quantitative manner. Potential impacts can be minimized by routing around sensitive habitats and appropriate mitigation measures can be implemented. The benefits of improved electricity services will outweigh the potential negative impacts.

Review of detailed information on sensitive species habitats and ranges indicates that the critical habitat is minimal and will not be directly impacted by the project. Natural habitat is present in the form of forested areas which will be avoided to the maximum extent possible; cleared forest areas will be offset by reforestation at 25:1.

The various "landscapes" such as Chitwan Annapurna Landscape (CHAL) and Terai Arc Landscape (TAL) are not legally protected areas. CHAL and TAL are formal designations for conservation initiatives, but there is no documentation that the areas which may be crossed by distribution lines are critical or natural habitats. These landscapes are similar to buffer zones which complement the legally protected areas, but the various landscapes are not legally protected areas or legally defined buffer zones.

Researchers note that tigers specifically disperse through sugar cane fields in northern India. The sugar cane fields are a "tall grasslands" analogy. Potential impacts on tiger and other ground-dwelling fauna in the various landscapes can be mitigated by allowing vegetation to grow to a height of 1 - 2 meters in the ROW. If necessary the distribution poles can be made higher than normal, and stacked conductor design might also be used.

Community forest management may be more effective at preserving biodiversity and sensitive flora and fauna that establishing new protected areas. To put this in context, since 1987, total protected areas in or partly covered by the CHAL have expanded from about 200,000 hectares to more than 1,240,000 hectares -- more than 562% -- but there is no obvious correlation between expansion of protected areas with improvement in biodiversity conservation.

The overall negative environmental impacts accruing from the Project are mostly minimal, site-specific, short-term, and reversible, and will occur primarily during construction. Issues of land acquisition and resettlement of households will have some negative impacts on socio-economic resources. Most of these negative impacts will occur during the construction phase. During the operational stage minimum effects will occur and these too can be minimized with appropriate provisions in the Environmental Management Plan (EMP). There are also several positive effects such as reduced emission of greenhouse gases which will in fact aid in the efforts made for conservation of environmental resources. NEA will have the overall responsibility of the EMP implementation.

Longer term impacts result from establishing the distribution right-of-way and new substations. Adequate compensation arrangements will be made for necessary land acquisition.

12.2 Conclusions and Recommendations

The proposed Project is the best alternative with respect to economic, environmental, financial, and social criteria. Potential negative environmental impacts can be mitigated by implementation of the EMP. The IEE and EMP will be updated and revised based on detailed surveys to ensure that environmental and ecological objectives in the project area are met.

The environmental assessment to date complies with ADB and Nepali policy and guidance for energy sector projects, and is sufficient to allow the Project to proceed to ADB Board consideration. Appropriate assurances should be incorporated into loan and project agreements to ensure that the IEE and EMP are updated as necessary and fully implemented.