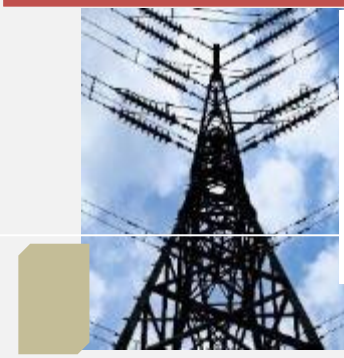
Task 2: Environmental and Social Assessment

# Detailed Feasibility Studies: Transmission Projects in Nepal

## Volume 2 (Report)

MCC-15-BPA-0032, MCC-16-CL-0002

March 2017



TETRA TECH

# Detailed Feasibility Studies
# Transmission Projects in Nepal

# Volume 2 (Report):
# Task 2: Environmental and Social Assessment

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MCC-15-BPA-0032, MCC-16-CL-0002

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# Acronyms

| | |
|---|---|
| AAPA | Aquatic Animals Protection Act |
| ADB | Asian Development Bank |
| CBS | Nepal Central Bureau of Statistics |
| CEDAW | Convention on the Elimination of all Forms of Discrimination against Women |
| CFUG | Community Forest User Group |
| CHAL | Chitwan Annanpurna Landscape |
| CITES | Convention on International Trade in Endangered Species of Wild Fauna and Flora |
| C-TIP | Countering Trafficking in Persons |
| DBA | A-scale decibels (noise unit) |
| DDC | District Development Committee |
| DFO | District Forest Office |
| DFRS | Nepal's Division of Forest Research and Survey |
| DFS | Detailed feasibility study |
| DNPWC | Department of National Parks and Wildlife Conservation |
| DTO | District Technical Office |
| EA | Electricity Act |
| EHS | Environmental, Health and Safety Guidelines |
| EIA | Environmental Impact Assessment |
| EIA/SIA | Environmental Social Impact Assessment |
| EMF | Electromagnetic field |
| EPA | Environmental Protection Act |
| EPR | Environmental Protection Rules |
| E/S, ES | Environmental and social |
| ESIA | Environmental and Social Impact Assessment |
| ESMP | Environmental and Social Management Plan |
| ESMS | Environmental and Social Management System |
| ESP | Environmental and Social Performance of MCC |
| ESSD | Environmental and Social Studies Department of the Nepal Electricity Authority |
| FECOFUN | Federation of Community Forestry Users Nepal |
| FESIA | Final Environmental and Social Impact Assessment |
| GBV | Gender-based Violence |
| GHG | Greenhouse gases |
| GII | Gender Inequality Index |
| GIS | Geographic Information System |
| GLOF | Glacial lake outburst flood |
| GoN | Government of Nepal |
| GRM | Grievance Redress Mechanism |
| HDI | Human Development Index |
| IEE | Initial Environmental Examination |
| IFC | International Finance Corporation |
| IUCN | The International Union for the Conservation of Nature |
| IWT | Initial Weighting Team |
| LAA | Land Acquisition Act of 1977 |

| | |
|---|---|
| LRT | Linear Routing Tool |
| masl | Meters above sea level |
| MCA | Multi-Criteria Analysis or Millennium Challenge Account |
| MCC | Millennium Challenge Corporation |
| MoE | Ministry of Environment |
| MOPE | Ministry of Population and Environment |
| NBAP | National Biodiversity Action Plan |
| NEA | Nepal Electricity Authority |
| NEPAP | Nepal Environmental Policy and Action Plan |
| NGO | Non-government organization |
| NPWCA | National Parks and Wildlife Conservation Act |
| NTFP | Non-Timber Forest Product |
| OMCN | Office of the Millennium Challenge Nepal |
| PESIA | Preliminary Environmental and Social Impact Assessment |
| RAP | Resettlement Action Plan |
| RFP | Request for quotation |
| ROW | Right of way |
| RPF | Resettlement Policy Framework |
| SEF | Stakeholder Engagement Framework |
| SLO | Social License to Operate |
| STD | Sexually Transmitted Diseases |
| STI | Sexually Transmitted Infections |
| SWCA | Soil and Watershed Conservation Act |
| TAL | Tarai Arc Landscape |
| TIP | Trafficking in Persons. The United Nations Protocol to Prevent, Suppress and Punish Trafficking in Persons, also referred to as the Trafficking Protocol or UN TIP Protocol |
| TL | Transmission line |
| TOR | Terms of Reference |
| UNCED | United Nations Conference on Environment and Development |
| USD | United States dollars |
| VAWG | Violence against women and girls |
| VDC | Village development committee |
| WCF | Ward Citizen Forum |
| WRA | Water Resources Act |
| WSP | Due diligence consultant (design) |

# Executive Summary

This report constitutes the Preliminary Environmental and Social Impact Assessment (PESIA) called for in Tetra Tech's contract with MCC. It was developed in support of the Government of Nepal's proposal to the Millennium Challenge Corporation (MCC) for a compact that would include the following proposed projects:

- NR1: 400 kV transmission line, total 270 km
  - Lapsiphedi to Naubise = 48 km
  - Naubise to New Hetauda = 41 km
  - Naubise to New Damauli = 98 km
  - New Damauli to New Butwal = 84 km
  - Lapsiphedi Substation
  - Naubise Substation
  - New Damauli Substation
  - New Butwal Substation
  - New Hetauda Substation

- XB1: 400 kV transmission line, 23 km
  - New Butwal to Nepal/ India Border

- T8: 400 kV transmission line, 47 km
  - New Lamki to Nepal/ India Border
  - New Lamki Substation

- T3: 220 kV transmission line, 30 km
  - Tadhekani to Kusma
  - Tadhekani Substation

- T2': 220 kV transmission line, 30km
  - Likhu Hub to New Khimti
  - Likhu Hub Substation

- NR3: 132 kV transmission line, 110 km
  - Ilam to Inaruwa

- NR4: 132 kV transmission line, 131 km
  - Balanch to Attariya.

In addition to the transmission lines and substations, the projects will require the construction of several access roads. These are generally short links to existing roads, except in the cases of Tadhekani and possibly Likhu Hub. Because other developers are active in some of the same locations as the proposed MCC projects, not all roads are the responsibility of the MCC Compact program, as presented in Table ES-1.

**Table ES-1. Substation Access Road Information (as of December 2016)**

| Substation | New access roads total length required (regardless of funding source) (km) | Segment of new road that is the responsibility of the MCC projects (km) | Donor/funding source; responsibility for road environmental assessment |
|---|---|---|---|
| Lapsiphedi | 5.0 | 0 | ADB |
| Naubise | 1.6 | 1.6 | MCC |
| New Damauli | 0.45 | 0.45 | MCC |
| New Butwal | 0.15 | 0.15 | ADB |
| Tadhekani | 19.8 | 19.8 | MCC |
| Likhu Hub | 0.45 | 0 | IPPs |
| New Lamki | 0 | 0 | |
| New Hetauda | 0.2 | 0.2 | World Bank |
| **Totals** | **27.65** | **22.00** | |

These roads are generally paved, and one will require a 60 m long bridge with the capacity to handle trucks carrying heavy equipment. No roads are expected to be built to access the tower sites, although temporary passage may be required across some agricultural land. The towers will be built at their sites, and materials and equipment are expected to be brought to the sites by porters or mules in the less accessible areas.

Several of the transmission lines will serve specific power generation facilities that are considered to be "directly associated facilities" and whose potential environmental and social impacts will need to be considered per the requirements of IFC Performance Standard 1.

This PESIA has been developed assuming that each proposed project is to be developed independently. However, the likelihood is that these projects would be implemented in four "packages" as described in Volume 1 and Section 2.1 of this PESIA.

## Regulatory Requirements

The PESIA was prepared according to the requirements of the International Finance Corporation (IFC), World Bank Group Safeguards, MCC's Environmental Guidelines, and applicable laws and regulations of the Government of Nepal. In addition, a new methodology was introduced with the application of a

participatory multi-criteria transmission line route selection process, which was used to avoid or reduce a number of potential environmental, social, and resettlement impacts prior to final route selection.

Nepal has a national framework for environmental and social assessment that is well established and documented extensively in the literature. With respect to the MCC Power Sector Project, the environmental authorities are the Ministry of Population and Environment and the Nepal Electricity Authority (NEA), whose Environmental and Social Studies Department has published a clear set of guidelines for conducting initial environmental examinations (IEEs) and environmental impact assessments (EIAs) for all projects that pass a screening test. Projects that pass the screening are implemented in accordance with national environment protection rules, including EPA (1997) and EPR (1997). It is assumed by MCC that Nepal IEE/EIA requirements, if applicable to the proposed project, will be fulfilled during the preparation of the full ESIA for the projects.

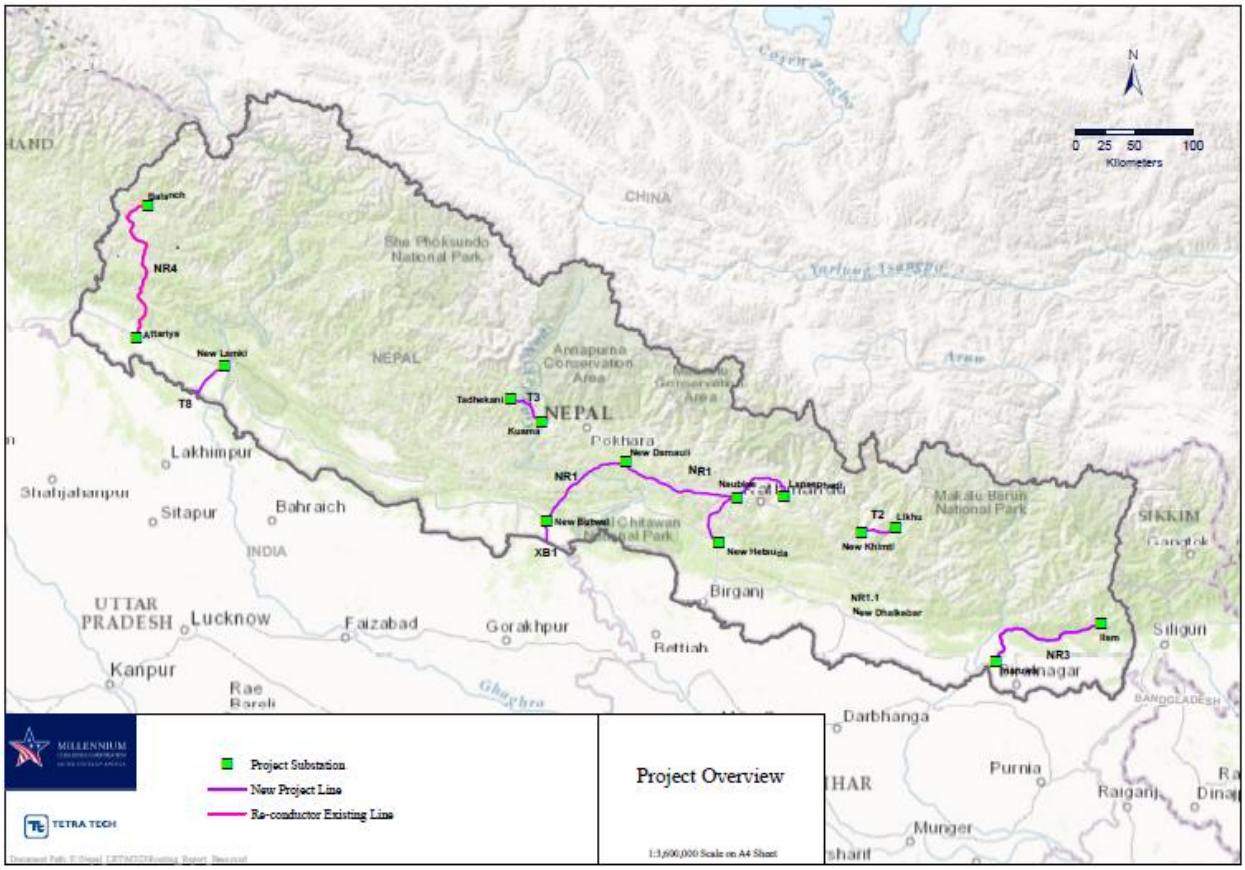


**Figure ES-1. Project Overview**

## Methodology for Multi-Criteria Route Selection of Transmission Lines and Substations

The traditional approach to stakeholder involvement in project siting consists of presenting a set of proposed and alternative sites (or routes) to the affected parties after the siting process has been essentially completed. The approach used here gives stakeholder representation throughout all phases of the siting process. The methodology that was applied created least constraint/cost solutions that were generated by transparent and reproducible methods. The process considers all available data and incorporated siting criteria developed by technical experts, in collaboration with stakeholders and their representatives. For each of the potential lines, this approach involved the following four steps:

**Step 1**. Gather and verify data in the form of geo-referenced GIS layers, and look at the general corridors suggested by the preliminary routes laid out by WSP (the due diligence consultant) and NEA (the electric authority) as a starting point for the routing process. The project benefited from receiving extensive GIS information on environmental issues from the World Wildlife Federation.

**Step 2**. Implement the Linear Routing Tool (LRT), Tetra Tech proprietary software that uses ESRI GIS. The process also involved providing weights to each of the attribute layers being used in the model. These weights were originally assigned by the multi-disciplinary team, and then modified using stakeholder preferences gathered in an October 2016 workshop and with responses to a questionnaire survey. The weights basically informed the model what features should receive higher importance than others when routing.

**Step 3**. The results of the LRT were then reviewed using multi-criteria analysis by overlaying the LRT-preferred routes on Google Earth and fine tuning the routes using current data, the local knowledge of the team's national experts, and the wishes of the stakeholders.

**Step 4**. These routes were then turned over to the engineers who used a program called PLS-CADD to do a preliminary design of the routes, again making minor route changes where needed by the design constraints.

Stakeholder engagement and consultation are vital parts of this feasibility study and the PESIA. As discussed above, stakeholder input has been integrated into the selection of the corridors, and it is expected that stakeholders will continue to be engaged during the duration of the compact project design, ESIA, construction and operation.

The Stakeholder Engagement Framework (SEF) is designed to:

- Define the policies and guiding principles for stakeholder engagement applicable to compact development
- Identify compact-wide stakeholder engagement and communication objectives and information needs during the compact development phase

- Identify compact stakeholders using a stakeholder mapping approach
- Define the activities, tools and procedures needed to complete the stakeholder engagement process during compact development, including redress of grievances and reporting
- Define roles and responsibilities to manage stakeholder engagement during compact development
- Establish parameters for ongoing stakeholder engagement during subsequent stages of the compact, including the development of stakeholder engagement plans for each compact project and the hand-off of stakeholder engagement data and plans from one stage to the next.

During the early part of the feasibility exercise, teams visited the Far Western, Middle and Eastern regions of Nepal in which substations and transmission lines were likely to be constructed, expanded or rehabilitated. The teams focused largely on district-level discussions, although a few community-level interactions were held. These exchanges provided useful input on the issues associated with earlier transmission line projects, and in gaining a better perspective of the potential risks that future investments might face in implementation, especially delay risks in the context of the MCC five-year compact period.

From a social and gender perspective, these site visits, although brief and not accompanied by structured surveys and focus group discussions, did highlight the needs and challenges faced by the diverse groups that make up the country's citizens. Poverty reduction, including both income and non-income, is a priority to Dalits in the Far West to indigenous peoples in the Middle and Eastern regions.

The proposed projects yield an important opportunity to provide benefits to those living in areas through which the transmission lines pass (line catchment area), particularly as there will be no benefits from power derived directly from those lines. This benefit sharing can be considered part of establishing a social license to operate (SLO). This is a concept used by different types of organizations to consider the level of approval accorded to their operations by a local community, including identifying proactive actions they can take to increase the likelihood of a positive relationship with communities in which they will work. Building an SLO is "good business." This is particularly true in the context of Nepal, where community opposition is known to delay infrastructure work. SLO is underlined by a moral imperative, given the extreme want of many of the communities that will be impacted by, but not directly benefit from, the establishment of transmission lines. Concepts for several potential projects have been identified as an outcome of the site visits and field discussions. There is a specific focus of the proposals on women, especially those from disadvantaged groups, as their participation in activities with higher return is limited by (i) lack of time, (ii) lack of access to economic assets and to marketing networks and technology, (iii) restricted mobility and risk-taking capacity, (iv) limited education and lack of vocational training, and (v) social discrimination on the part of employers. The concepts, which are described in Annex F of the PESIA, will attempt to address the challenges posed by (ii)-(iv).

## Findings

### Existing Baseline Conditions

The proposed projects are situated throughout Nepal. PESIA Sections 4.1 and 4.2 present a summary of the existing or baseline environmental and social conditions in all parts of Nepal that apply in general to all the proposed projects, followed by more detailed project-specific information. The project-specific sections, starting at Section 4.3, cover the following topics (as appropriate) for each project:

- **Physical** (covering geophysical issues such as seismic danger, flooding risk, slope, erosion, landslide potential, and soils; water quality and water resources; air quality and noise; hazardous materials/waste; and, greenhouse gas emissions)
- **Ecological** (including protected areas, rare and endangered species habitats and wildlife corridors, important bird areas, and ecosystem services)
- **Socio-economic** (discussing general impact on national economy, general impact on local/regional, gender issues, such as the potential for gendered differences in impacts, potentially affected households, agriculture, communities, indigenous and vulnerable people issues such as changes in population expected changes in governance, institutions or practices, formal or territorial disputes, and changes in land use or other economic uses of affected lands; land use, including urban, agricultural/pastoral, and various types of forests.
- **Cultural** (including temples, sacred forests, visual resources, and touristic resources).

### Climate Change

There are two ways to consider the effects of climate change for the MCC transmission line program: 1) the effect of the transmission lines on the production of greenhouse gases (GHG) that would contribute to climate warming, and 2) the effect of climate change on the transmission lines. Both aspects are addressed in the PESIA and recommendations are made regarding types of materials that reduce GHG emissions as well as minimizing the taking of forest lands which provide $CO_2$ sequestration. Climate change can also adversely affect the project. For example, by raising the risk of catastrophic flooding from glacial lake outburst floods (GLOFs) caused by the formation of unstable glacial lakes that eventually overflow or burst due to continued warming. This would threaten any transmission lines that were downstream of the GLOF events unless they were out of the GLOF flood plain. Given their location, T3 and T2' are most likely to face these risks, but all projects will be subject to other climate change risks such as floods and strong storms.

### Project Screening

The MCC Environmental Guidelines state that "as early as possible in the Compact proposal review process, MCC will screen each project as described in these guidelines. As part of its review of Compact proposals, MCC funding decisions will be informed by the results of screening and, where needed, an Environmental and Social Impact Assessment or other environmental and social impact analysis. To that end, MCC will not fund a project unless there is provision for appropriate screening and appropriate environmental and social impact analysis."

The proposed projects to be funded under the compact have been subjected to a preliminary screening based on desk studies, limited field observations and stakeholder contributions, and inputs from knowledgeable local experts. The screening results have been captured in checklists (Annex A of the PESIA). Six of the seven proposed projects fall under Category A, requiring a full ESIA, while one project (NR4) is Category B, requiring only an environmental evaluation and Environmental and Social Management Pan (ESMP).

### Transboundary Impacts

The MCC Environmental Guidelines include procedures that MCC is required to use to implement Executive Order 12114, which requires that projects that may have impacts in countries other than the one that will host the projects be submitted to an environmental evaluation of those impacts and information sent to the US State Department. It is reasonable to assume that India may experience some environmental or social impacts from needed infrastructure to be developed on the India side to accommodate the program. These impacts might range from those related to new or enhanced transmission lines, substations, or even additional electricity generation. Impacts beyond the Nepal border are not addressed in this PESIA; however, it is recommended that MCC investigate whether Executive Order 12114 is applicable to these potential Compact projects. If MCC determines that Executive Order 12114 applies, it should proceed with an environmental review of transboundary impacts and contact the State Department to coordinate discussions with India.

### Environmental and Social Impact and Mitigation Measures

The PESIA presents a summary of potential impacts and mitigation measures that are common to all the projects and all regions, followed by individual project-by-project assessments. Field inspection of all alignments for the preliminary ESIA was not possible. This was primarily caused by the length of line, in excess of 600 km, most of it through inaccessible terrain, the compact time frame within which this PESIA would be developed, and the fact that alignment routings and substation designs and specifications were being developed simultaneously with the environmental and social research and analysis.

To compensate for these challenges, a multi-level impact evaluation process was utilized in conjunction with transmission line and substation routing and location decisions described earlier, more than two dozen selected site visits, and a multidisciplinary visual inspection of detailed satellite imagery. This approach serves as starting point for the more detailed analysis to be conducted during the preparation of the final ESIA.

Transmission line projects generally have less significant impacts than other infrastructure activities. While new substations and transmission line towers will have perceptible impacts in the acquisition of lands and attendant involuntary resettlement implications (which are dealt with separately as part of the resettlement planning and implementation process), the general impacts of the lines are not considered significant, except perhaps in forest areas in which trees will have to be coppiced or removed and right of ways (ROWs) cleared. These actions may have impacts for access to non-timber forest products and potential loss of incomes. Table ES-2 presents the impacts and mitigations measures applying in general to all the proposed projects.

**Table ES-2. General Impacts and Mitigation Measures for Proposed Projects**

| Environmental concern | Significant environmental impacts without mitigation | Required mitigation measures (see detailed information in the ESMP) |
|---|---|---|
| **Detailed design phase** | | |
| Hydrological Impacts | Untreated runoff or wastewater negatively affecting quality or flows of water courses | Design/construct and maintain drains and retention structures to eliminate impact |
| Wetlands | Small areas of disturbance. Potential negative impacts to these habitats. | Routing avoidance; slit screens; restoration post-construction |
| Accessibility | Impacts unlikely | MAPF; disabled access provided |
| Soil Erosion | Earth borrows quarries and disposal for access roads and towers. Erosion and impacts to water courses. | Use existing borrow and disposal pits; erosion protection measures |
| Impact of Borrow Pits, Quarries and Waste Disposal | Unlikely to need new facilities. Erosion and habitat impacts could occur. | Obtain proper offsite permits from local officials, and document all locations and permits |
| Landslides | Possible on ridges. Improper tower siting may cause landslides. | Follow Nepal landslide prevention standards |
| Safety | Issues always likely. Workers and local populations exposed to construction hazards. | Fences, signs, and all applicable design safety standards; community awareness training |
| ROW Environmental Impacts | Scattered areas of critical habitat may be encountered. Potential negative impacts to these habitats. | Avoid tower placement in areas of critical habitat; install transmission lines above vegetation; limit construction during breeding season; remove invasive species; integrated vegetation management. *(Note A)* |
| Aquatic Habitat | Line will cross occasional wetlands and fish habitat. Potential negative impacts to these habitats. | Avoid siting towers in wet areas; use clear span bridges for access roads, open bottom culverts; minimize disturbing riparian vegetation. *(Note A)* |
| Electric and Magnetic Fields (EMF) | Potential exposure when crossing inhabited areas. Impacts of EMF not clear, so should be avoided. | Evaluate exposure according to standards of International Commission on Non-Ionizing Radiation Protection; if below standards, implement protective engineering measures. *(Note A)* |
| Visual Aesthetic | Transmission lines and towers | Wherever possible, the design should place the lines |

**Table ES-2. General Impacts and Mitigation Measures for Proposed Projects**

| Environmental concern | Significant environmental impacts without mitigation | Required mitigation measures (see detailed information in the ESMP) |
|---|---|---|
| Value | along the valleys and on ridges in the Middle Hills and Tarai[1] area would reduce scenic beauty and attraction for tourists. The overall magnitude of impact is considered to be low, its extent local, but its duration long term. | below the ridgeline of the mountains to avoid protrusion of towers and lines, and enable the transmission line profile to merge with the existing landscape. |
| **Construction phase** | | |
| Inadequate environmental awareness of workers | Likely to be instances with subcontractors, leading to violations of the ESMP requirements | Contractors to retain environmental health & safety officers. Conduct special and regular briefings and trainings. *(Note B)* |
| Water Quality | Temporary impacts highly likely from spillages, wastewater disposal, and onsite solid waste disposal. Could affect surface or groundwater. | Operator training; maintain lubricant and fuel storage facilities and procedures; properly designed drainage system; 50m standoff of facilities and construction from receiving water bodies; onsite dumping prohibitions; vehicle and machine maintenance enforced; sanitation facilities and wastewater treatment at work sites and construction camps. |
| Air Quality/Dust | Likely only at substation construction sites. Increased levels of respirable particulate matter above health-related standards leading to health issues for workers or local populations. | All machinery to be fitted with air quality control equipment to IFC and national standards; use Euro IV diesel fuel when available; enclosing sand stockpiles & wind barriers; providing all-weather roads where there is regular vehicle movement; wetting of other roads; closed storage of cement materials and aggregate; fuel efficient vehicles, idle engine turnoff; onsite vehicle washing; dust control measures. |
| Noise/Vibration | Exceedance of standards likely at substations and temporarily at tower construction sites, especially where piles need to be driven. | Noise abatement gear for vehicles and powered mechanical equipment; daylight operation restriction near populated areas; maintenance of equipment and vehicles, especially mufflers; speed controls; acoustic screens near sensitive receptors (schools, temples, etc.). |
| Soil Erosion and Soil Contamination | Likely at substations and tower construction sites (temporary) | Complete drainage works to be designed and maintained; strengthen steep slopes; proper disposal of |

[1] A common spelling of the word “tarai”is “terai”. “Tarai” is used in this document, but some of the sources cited use “terai”, and that spelling is kept when the source is specifically referenced.

**Table ES-2. General Impacts and Mitigation Measures for Proposed Projects**

| Environmental concern | Significant environmental impacts without mitigation | Required mitigation measures (see detailed information in the ESMP) |
|---|---|---|
| | | extracted soils; avoid use of arable land for borrow and fill; restoration of cover as soon as feasible. |
| Handling and Storage of Hazardous Materials | Unlikely, and limited to construction yards | Constructed storage areas on impermeable surfaces; safe ventilation practices; controlled access procedures; use of refrigerants and fire extinguishing materials in accord with the Montreal Protocol. |
| Landslides | Possible but unlikely | Use of landslide prevention measures; careful use of excavation equipment so as not to destabilize topsoil layers. |
| Damage to Historic/Cultural Monuments | Unlikely after studies during detailed design are complete | Training of workers in artifact recognition; immediate cease work provisions in case of finds; prior coordination with Ministry of Culture regarding procedures; documentation of findings; rarely, design avoidance/preservation features. *(Note C)* |
| Work Camp/ Temporary Yard Operation and Location | Wherever present. Possible tree cutting; water and sanitation impacts; solid and hazardous waste releases; failure to maintain waste separation, collection and transport away from site; failure to restore / revegetate the site; potential for local women as well as women workers to be harassed and abused in work camps and temporary yards | Avoid settlements where possible; avoid tree cutting; provide water & sanitation; manage solid, hazardous waste and sewerage; maintain waste separation, collection & transport away from site; site restoration, re-vegetation; inspect & validate that site is returned to pre-project conditions; separate and secure living space, adequate on-site lighting, separate and secure sanitary facilities for women workers. Awareness-raising/training for workers on gender/women's rights to security, Nepalese laws and what constitutes harassment. Effective, anonymous and accessible grievance policies and procedures to be in place and fully implemented. |
| Worker safety | Wherever present. Workers exposed to construction hazards. | Engineer-approved EHS plan, to include: warning signs; personal protective equipment; worker training; vehicle & equipment training, licensing; first aid and medevac transport available; regular safety checks; maintian24-hour emergency contact lists; provide HIV/AIDS & STD awareness training and testing. |
| Traffic management and construction safety | At all construction sites, long term or short term. Traffic-related accidents and congestion in roads used | Prepare & enforce traffic management plan, to include, *inter alia,* traffic warning signs and regulations enforcement; awareness program; traffic control personnel/flaggers; alternative pedestrian access; |

**Table ES-2. General Impacts and Mitigation Measures for Proposed Projects**

| Environmental concern | Significant environmental impacts without mitigation | Required mitigation measures (see detailed information in the ESMP) |
|---|---|---|
| | during construction. | arrange passer-by safety; select quarry and borrow sites with capacity for heavy trucks; vehicular speed control; road damage repair; local authority approval for use of local roads |
| **Operational phase** | | |
| Bird Protection | All valley crossings and designated flyways. Significant bird mortality due to collisions with conductors or towers. | Install reflectors on all transmission line major river crossings and in areas of frequent fog. Plant tall growing trees outside ROW to encourage birds to fly higher and avoid trees and lines; include nest and resting platforms on towers for raptors and vultures. *(Note A)* |
| ROW Maintenance | Throughout route, and especially through community forests. Improper maintenance of the ROW leading to potential vegetation reaching too close to the conductors. Increased erosion on steep slopes. Potential use of herbicides could affect nearby agricultural lands or water courses. | Develop and implement vegetation management plan to provide local job opportunities and income supplementation, for local communities, especially women and vulnerable people[2]. The management plan should include a tripartite agreement among the three groups: Community Forest User Groups in the locality, DFO and the Transmission Line maintenance authority to manage the vegetation in the ROW.<br>Avoid use of pesticides and herbicides where possible; otherwise, train and certify personnel in safe application procedures. |

*Notes:*

A. Detailed location and extent of problem areas shall be determined during preliminary design phase.
B. Individual contractors shall be asked to fill in questionnaire to be prepared and administered by client environmental health and safety officer.
C. All known sites have been avoided during feasibility studies. Further site investigation will be needed during detailed design phase and prior to construction.

[2] This PESIA uses the following definition of "vulnerable people" which represents the complexity on the linkage between vulnerability and poverty in Nepal: "*Vulnerability is a multi-layered and multidimensional phenomenon which refers to the risk or exposure of an individual or group of individuals to events that threaten or damage one or more aspects of wellbeing. Vulnerability therefore can be seen as cause (e.g. living in ecologically fragile areas increases vulnerability and may result in longer term poverty), symptom (e.g. those living in chronic poverty are by definition more vulnerable than the non-poor), and a constituent element of poverty (e.g. higher levels of vulnerability increasingly seen as part of the very definition of poverty)*." UK DFID. Regional Dimensions of Poverty and Vulnerability in Nepal. Background Report 1: Defining Chronic Poverty and Vulnerability. 2013. Page 8.

### Socio-Economic Impacts

The social and gender impacts of the transmission line are limited. However, with extensive forest cover, particular attention will have to be given to addressing the concerns of forest users whose access to non-timber forest products (NTFPs) may be restricted by the transmission lines and who may face losses owing to the ROWs established for the lines. Of primary interest to affected people will be the implementation of a fair and prompt compensation program for their losses. Construction phase impacts such as trafficking in persons (TIP) and HIV/AIDS will need to be addressed through strong mitigation measures in the construction contracts and with comprehensive monitoring.

### Analysis of Alternatives

The alternatives considered in the PESIA are:

- "Preferred alternatives," which are the projects defined using the multi-criteria analysis followed by the PLS-CADD design. The process considered many variations in the line routings to minimize or avoid impacts for each of the lines. The "final" lines are discussed in detail in Chapter 6 of the PESIA.
- "Initial alternatives," which were lines and substation locations defined by the MCC due diligence technical consultants based on desk studies performed by NEA.
- "No action," which implies that the projects would not be performed under the MCC compact.

There are also design alternatives which have been considered during the feasibility level engineering. These primarily deal with technical options such as the use of air or gas insulation in the substations, the types and height of towers, and other technical features. It is recommended that these options be looked at during the preliminary design stage in the full ESIA to assess their environmental advantages (for example, smaller footprints for the substations) and their environmental disadvantages (such as the need to modify streams or do extensive excavations).

### Environmental Management

The PESIA includes an outline for an Environmental and Social Management System (ESMS). An ESMS is designed to set policy and specific measures for mitigating adverse impacts and monitoring compliance with the Nepalese and international environmental and social performance standards for large infrastructure projects. The ESMS for the MCC Nepal program is being developed by MCC's ESP due diligence consultants and will be applied to the activities of the GoN organization responsible for the implementation of the Compact projects.

The PESIA also includes an Environmental and Social Management Plan (ESMP) that will become an integral part of the construction contracts, and includes the following sections:

- Introduction
- Objectives of the ESMP
- Summary of Environmental and Social Impacts
- Mitigation Measures
- Environmental and Social Monitoring Plan

- Institutional Arrangements
- Implementation Schedule
- Recommended Special Contract Clauses for Environmental and Social Protection During Construction.

### Costs

The environmental and social costs for the project fall into two categories:

- Costs for the implementation of the ESMP including Environmental Mitigation Costs (not including land acquisition) and
- Benefit-sharing Costs.

Benefit-sharing can take many forms as has been shown by the World Bank and others. Most often benefit sharing programs are features of hydropower projects where there is a reasonably well-defined projection of revenues that can be shared. In those cases, benefit-sharing programs have ranged from 1 to 9% of annual gross sales or revenues. In the case of the MCC transmission lines, the funding mechanism for benefit-sharing is described as a "system benefit charge" that is applied to the predicted financial annual capital recovery amounts for the projects. As of this writing, this "system benefit charge" is taken as 5% of annual capital recovery, based on recovery over 5 years at 10%.

Table ES-3 shows estimates of the environmental costs associated with the project lines. The environmental costs illustrated in this table were computed using a "bottom-up" approach in which all mitigation and monitoring activities to be applied to a project were cost-estimated independently and then summed to come up with the environmental costs. Details of this approach can be found in Annex K of Volume 2. The environmental cost estimates will be revised and updated based on subsequent design refinements and the more detailed environmental and social information gathered during the preparation of the FESIA. Benefit sharing programs are often features of hydropower projects where there is a reasonably well-defined projection of revenues that can be shared. In those cases, benefit-sharing programs have ranged from 1 to 9% of annual gross sales or revenues. In the case of the MCC transmission lines, the funding mechanism for benefit-sharing can be described as a "system benefit charge" that is applied to the predicted financial annual capital recovery amounts for the projects. As of this writing, benefit sharing is estimated as 3.8% of the total capital cost of the program. Annex K has details on how this was calculated, including assumptions. However, benefit sharing budgets should be identified after negotiations between MCC and GoN and with input from stakeholders. The total cost of the Proposed Benefit-Sharing Program over the life of the compact is estimated at USD 19.8 million.

### "Full or Final ESIA"

The final section of the PESIA presents the Terms of Reference (TOR) and a cost estimate that are designed to guide the development of the Final Environmental and Social Impact Assessment (FESIA) and Environmental and Social Management Plan on the priority transmission lines projects that have been proposed by the Government of Nepal. These priority projects would be included for funding in a possible grant agreement with the MCC. It is proposed that the FESIA be performed during the CIF period prior to the compact's entry into force. It is expected that four FESIAs would be prepared, one

per construction package, at a total cost of approximately $4 million (see details of this estimate in Annex K). It is important that the schedule to prepare the FESIA allow for the integrating Nepalese EIA requirements, which could significantly extend the period of performance to allow for approvals and public disclosure.

**Table ES-3. Estimated Project Environmental Costs**

| Line ID: | Total Construction Cost (million USD) | Environmental Mitigation and Monitoring Cost (million USD) | Annual Benefit Sharing Cost Allowance (million USD) | Total Benefit Sharing Cost over the Compact (million USD) |
|---|---|---|---|---|
| NR1 | $385.61 | $6.92 | $2.17 | $8.21 |
| XB1 | $9.78 | $0.69 | $0.18 | $0.69 |
| NR3 | $15.78 | $1.99 | $0.90 | $3.40 |
| NR4 | $4.01 | $1.46 | $1.03 | $3.91 |
| T2' | $25.29 | $1.12 | $0.28 | $1.06 |
| T3 | $37.97 | $1.73 | $0.29 | $1.09 |
| T8 | $38.70 | $0.89 | $0.37 | $1.41 |
| ***Total*** | ***$517.15*** | ***$14.82*** | ***$5.22*** | ***$19.77*** |

Note: Total Construction Cost is defined as the total technical cost plus contingency, not including resettlement or MCC / MCA-N management costs

| | |
|---|---|
| **Estimated Cost of the four (4) ESIAs for the four (4) packages** (million USD) | $4.07 |

**Assumptions (Please see Annex K for more detailed list of assumptions)**

| | |
|---|---|
| Total 5-year ESMP and ESMS Implementation Cost (This is a management cost accruing to MCA-N that covers all lines; not included in the Mitigation / Monitoring Costs above which will be part of the Construction Contracts) (million USD) | $0.85 |
| Total Construction Cost Percent Needed for Environmental Mitigation and Monitoring | 2.86% |
| Total Construction Cost Percent Recommended for Benefit Sharing | 3.82% |

Figure ES-2 shows an indicative schedule for accomplishing the ESIA. The schedule is subject to change during the period that the final ESIA is prepared. Furthermore, the work of the ESIA is subject to the progress on the Preliminary Design and the RAP, as indicated schematically in the schedule.

| | ESIA Schedule | | | Year 1 | | | | | | | | | | | | Year 2 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Activity ID | Activity Name | Duration (m) | Precedent | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D |
| 1.00 | Preparation of Preliminary Designs | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.50 | Preparation of Final Designs | | 3.05 | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.00 | Milestone: Completion of the RAP | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.00 | **Preparation of ESIA (for each package)** | 18 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.01 | Scoping | 2 | 1.00 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.02 | Regulatory Requirements | 1 | 3.00 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.03 | Description of Proposed Activities | 2 | 3.00 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.04 | Description of Baseline Conditions | 9 | 3.03 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.05 | Determination of Potential Impacts | 7 | 2.00 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.06 | Analysis of Alternatives | 3 | 3.04 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.07 | Environmental and Social Management Plans | 4 | 3.06 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.08 | Benefit Sharing Mechanisms | 4 | 3.06 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.09 | Indigenous Peoples Assess (PS 7+ IPP if needed) | 9 | 3.03 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.10 | Biodiversity Assess. (PS 6 + BAP if needed) | 6 | 3.03 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.11 | Report Preparation (Draft & Final ESIA) | 4 | 3.07 | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.00 | Approvals / permits | 4 | 3.10 | | | | | | | | | | | | | | | | | | | | | | | | |
| 5.00 | Stakeholder Engagement and Public Disclosure | ongoing | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |

**Figure ES-2. Schedule for Preparation of the ESIA**

## Conclusions

The main areas of potential environmental impacts ascertained in this PESIA are:

- Forest resource impacts do to the need to have safe clear-cut zones beneath the power lines
- Erosion (impacts on slope stability and aquatic resources) from construction activities
- Climate change (likely to be positive impacts due to reduction in use of diesel back-up generators)
- Bird migration conflicts with power lines

In terms of social impacts, the following concerns were investigated:

- Potential lack of access to community forest resources including NTFPs
- Implementation of a fair and prompt compensation program
- Lack of benefits to local stakeholders from the high voltage lines that would not bring electrification to all areas that they cross
- Construction phase impacts such as TIP and HIV/AIDS, which will need to be addressed through strong mitigation measures in the construction contracts and with comprehensive monitoring

These potential impacts can and should be mitigated through the application of a comprehensive Environmental and Social Management Plan (ESMP). Therefore, the PESIA process has not identified any fatal flaws (defined as non-compliance with any IFC Performance Standard, even with mitigation). It is concluded that the transmission line projects could be built with minimal environmental and social impact if the ESMP is complied with, the resettlement and compensation issues are properly addressed in the RPF and the resettlement action plans (RAPs) are developed during the preliminary and final designs. Due to the limitations of the PESIA process, it is further recommended that the results and conclusions be reviewed and, as appropriate, revised as part of the development of the FESIA.

# 1. Policy, Legal, and Administrative Framework

## 1.1 Purpose and Method of Review

The approach and methodology for Task 2 was largely determined by the requirement that the preliminary ESIA be prepared per standards and procedures set by the International Finance Corporation (IFC)/World Bank Group Safeguards, MCC's environmental guidelines, and applicable laws and regulations of the Government of Nepal. In addition, for this project, a new methodology was introduced with the application of the participatory multi-criteria transmission line route selection process, which holds promise to ameliorate several potential environmental and social (E/S) impacts prior to final route selection.

## 1.2 Nepalese Regulations

Nepal's national framework for environmental and social assessment is well established and documented extensively in the literature. With respect to the MCC Power Sector project, the applicable authority is the Nepal Electricity Authority (NEA); its Environmental and Social Studies Department (ESSD) has published a clear set of guidelines for conducting Initial Environmental Examinations (IEEs) and Environmental Impact Assessments (EIA) for all projects that pass through a screening test and are implemented in accord with national environment protection rules.[3] MCC has assumed that Nepal's IEE/EIA requirements, if applicable to the proposed project, will be fulfilled during the full ESIA stage of the project. It is nevertheless important to note at this point that no application should be made to the Department of Electricity Development for a "survey license" under Nepalese Environmental Rules at any stage unless and until MCC desires to start the Nepal IEE/EIA process, as the application for such a license is a triggering event under Nepal environmental procedures.

### 1.2.1 Conservation-Related Legislation and Policy

Nepal has enacted many laws, rules and regulations and is signatory to various international conventions for the conservation and development of natural resources, including forests and wildlife.

[3] Environment Protection Act, 2053 (1997); Environment Protection Rules, 2054 (1997); Nepal Electricity Authority, Operational Manual of Environmental Social Impact Assessment (EIA/SIA) for Sub-Projects Financed Under the Additional Financing of the Power Development Project (Revised April 2009) http://www.nea.org.np/images/supportive_docs/EIA%20SIA%20Framework%20for%20Additional%20IDA%20Financing%20Draft.pdf

However, demographic, socio-economic, political, and institutional conditions have not always permitted the full implementation of these legal and non-legal provisions. The Government of Nepal (GoN) does recognize these constraints and is finding ways and means to deal with them. For example, Nepal is attempting to improve the condition of forest resources through the increased participation of all stakeholders and increasing the capacity of local institutions that deal with natural resources.

The Constitution of Nepal gives high priority to conservation of natural resources and provides special protection to endangered wildlife, flora and forests. Nepal has responded to constitutional needs by enacting laws and regulations relating to forests, wildlife and biodiversity. In addition to the Forest Act (1993), Nepal has other supplementing laws that cover almost all concerns relating to the environment, including the areas of land use, forests, water, mining, cultural heritage, occupational health and noise pollution. For example, the Environment Protection Act (1996) and the Environment Protection Regulations (1997) contain broad legal provisions that directly or indirectly support sustenance of forest resources.

**Forest Act (1993)**

The Forest Act of 1993 has a broad definition of forests: "all forests areas whether marked or unmarked, within the forest boundary including wasteland and uncultivated lands or unregistered lands surrounded by the forest or situated near the adjoining forest as well as paths, ponds, rivers or streams and riverine lands within the forest land." This Act respects all forest values, including environmental services and biodiversity, as well as the production of timber and other commodities.

The provisions of this Act relating to protected forests, community forests and leaseholds forests have short-term as well as long-term impacts on the conservation and sustainable management and use of forest resources. The Act empowers the GoN to delineate any part of a national forest that has a special environmental, scientific or cultural importance as a protected forest. The Act directs the Department of Forests to prepare an operational plan for each protected forest in Nepal and directly contributes to the conservation of biodiversity in areas that are even located outside existing national parks and reserves.

The Act empowers GoN to grant any part of a national forest, in a manner conducive to the conservation and development of forests, to produce raw materials required by industries, plant trees to increase the production of forest products for sale, operate a tourism industry or to implement agroforestry.

Various rules, including the Forest rules (1995), Private Forest rules (1981), Panchayat Forest rules (1978), Panchayat Protected Forest rules (1978) and Leasehold rules (1978), supplement the legislative provisions of the Forest Act.

Notwithstanding that the Forest Act and regulations do not explicitly deal with rangeland, the implementing rules requiring the licensing of grazing animals and pasturage, and imposing pasture charges, provide implicit control of the Forest Act over rangelands and their use.

**National Parks and Wildlife Conservation Act (NPWCA), 1973**

The Wildlife Conservation Act of 1957 was the first to identify the importance of protecting wildlife in Nepal and it also led to the enactment of the National Parks and Wildlife Conservation Act in 1973. This Act provides for the conservation of natural areas and wildlife and regulates the consumptive and non-consumptive uses of biodiversity to sustain the welfare of the people.

The Act empowers the GoN to establish six different kinds of protected areas: national parks, wildlife reserves, strict nature reserves, hunting reserves, conservation areas, and buffer zones, and to develop site-specific and general regulatory mechanisms for their conservation. The Act also provides special and complete protection to 38 endangered species: 26 species of mammals, 9 species of birds, and 3 species of reptiles. The NPWCA has been recently amended to incorporate the concept of buffer zones and to facilitate public participation in the conservation, design and management of these zones.

This Act is supplemented by several other associated acts as the Aquatic Animals Protection Act (1961), the King Mahendra Trust for Nature Conservation (1982), the Forest Act (1992) and Soil Conservation Act (1982). International conventions such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973, the Ramsar Convention for Wetlands Conservation, 1971, and the World Heritage Convention, 1975, further strengthen biodiversity conservation and protection efforts in Nepal.

**Environment Protection Act (EPA), 1996**

The enactment of the Environment Protection Act has led to the development of guidelines for mandatory Environmental Impact Assessments and establishment of an Environment Protection Council. Environmental assessment guidelines have been developed for the industry, forestry and water resources sectors to identify, predict and evaluate potential environmental impacts and to develop mitigation measures for adverse impacts.

**Aquatic Animals Protection Act (AAPA), 1961**

This Act is one of the oldest acts in Nepal that recognizes the value of wetlands and aquatic animals. Under the Act, any party is punishable for introducing poisonous or explosive materials into a water source or destroying any dam, bridge or water system with the intent of catching or killing aquatic life. It also defines “private water” as a lake, pond, ditch, pool or reservoir that is on land used by a person who has been paying land tax to the government. Although the Act has been in effect for quite some time, there is no designated agency to administer it.

**Soil and Watershed Conservation Act (SWCA), 1982**

SWCA empowers the GoN to declare any area as a protected watershed to limit the degradation of land by floods, water-logging, and salinity in irrigated areas and the acceleration of siltation in storage reservoirs, and to properly manage the watersheds of Nepal. The Act of 1982 and its regulations of 1985 together provide the legal basis for managing watersheds. The Act also outlines the essential parameters necessary for proper watershed management including both rivers and lakes.

**Water Resources Act (WRA), 1992**
The Water Resources Act vests the ownership of water resources with His Highness the King of Nepal. The Act strives to minimize environmental damage to wetlands, especially lakes and rivers, through environmental impact assessment. The Act makes these assessments a mandatory prerequisite for water resource and electricity projects. The Act provides a legislative model for the development of environmental impact assessments. Guidelines issued for environmental impact assessment of the water resources (irrigation and power) sector projects supplement the legislative provisions of the Act.

**Electricity Act (EA), 1992**
The Electricity Act prohibits negative environmental impacts (soil erosion, flooding, landslides and air pollution) while generating, transmitting or distributing electricity.

### 1.2.2 International Conventions

Nepal is a signatory to many forest-related international conventions that require more effective control and authority over forest resources. The GoN seeks to achieve this through increased participation of all stakeholders and especially local users. Presented below are some of the important environment-related conventions signed by the government.

**Ramsar Convention**
The Ramsar Convention which is also known as the Convention on Wetlands of International Importance was signed by Nepal on 17 April, 1988.. As shown in Table 1, Nepal currently has 10 Ramsar sites designated, with a surface area of 60,561 hectares[4].

Many wetlands in Nepal are subject to land and water pollution while many others have been drained and converted to agricultural land. The Nepal Environmental Policy and Action Plan (NEPAP) (1993) has given high priority to the identification and protection of marshes, wetlands and water bodies that are significantly rich in biodiversity. This plan also recommended a study to assess the biological diversity of endemic plants and animals – both terrestrial and aquatic – that occur outside protected areas, on farmlands, pastures, rangelands, forests, rivers, lakes and ponds. NEPAP is an effective initiative for the protection of wetlands and has provided a good policy foundation for development of the National Biodiversity Action Plan (NBAP).

**Convention on the Protection of the World Cultural and Natural Heritage**
Nepal signed this binding agreement that calls on Nepal to identify, protect and conserve its natural and cultural heritage, and to integrate such protection and conservation into national planning. The World Heritage Convention (1973) recognizes the interest of the world community in certain parts of the

[4] https://rsis.ramsar.org/ris-search/?solrsort=country_en_s%20desc&f[0]=regionCountry_en_ss%3AAsia&f[1]=regionCountry_en_ss%3ANepal&pagetab=1. Accessed 7 Jan 2017

environment that are of "outstanding universal value" and defines cultural and natural heritage in broad terms. The natural heritage includes natural features that may contain physical and biological formations or groups of formations, geological and physiographic formations, specific areas that constitute the habitat of threatened animal and plant species and natural sites or precisely delineated natural areas. Whenever a site meets the requirements of either cultural or natural heritage, the country on whose territory it is situated has the obligation to preserve it, irrespective of whether it has been included on the World Heritage List or not.

Table 1. Ramsar Sites in Nepal

| Site Number | Ramsar Sites | Region/ District | Location | Area (ha) | Zone | Altitude (m) | Designation Date |
|---|---|---|---|---|---|---|---|
| 380 | Koshi Tappu | Sumsari | 26°39` N 086°59` E | 17500 | Tarai | 90 | 17-12-1987 |
| 1313 | Beeshazar and Associated Lakes | Chitwan | 27°37` N 084°26` E | 3,200 | Tarai | 285 | 13-08-2003 |
| 1314 | Ghodaghodi Lake Area | Kailali | 28°41` N 080°57` E | 2,563 | Tarai | 205 | 13-08-2003 |
| 1315 | Jagadishpur Reservoir | Kapilvastu | 27°35` N 083°05` E | 225 | Tarai | 195 | 13-08-2003 |
| 1692 | Gokyo and Associated Lakes | Solukhumbu | 27°52` N 080°42` E | 7,770 | Himal | 5000 | 23-09-2007 |
| 1693 | Gosaikunda and Associated Lakes | Rasuwa | 28°05` N 085°25` E | 1,030 | Himal | 4700 | 23-09-2007 |
| 1694 | Phoksundo Lake | Dolpa | 29°12` N 082°57` E | 494 | Himal | 3610 | 23-09-2007 |
| 1695 | Rara Lake | Mugu | 29°30` N 082°05` E | 1,583 | Himal | 2990 | 23-09-2007 |
| 1850 | Mai Pokhari | Ilam | 27°00'N 087°56'E | 90 | Midhill | 2100 | 20-10-2008 |
| 2257 | Lake Cluster of Pokhara Valley | Gandaki | 28°12'N 83°59'E | 26,106 | Midhill | | 02-02-2016 |

Nepal has been successful in fulfilling its obligations under World Heritage Convention primarily through the implementation of the National Parks and Wildlife Conservation Act of 1973. Nepal's natural heritage is protected in two world heritage sites" Royal Chitwan National Park and Sagarmatha National Park. Recently, Nepal has been preparing to propose Shey-Phuksundo National Park for inclusion in the list because of its unique cultural and natural properties.

**Convention on International Trade in Endangered Species of Wild Flora and Fauna**

Since 1975, Nepal has been a signatory to CITES, which requires controls on international trade in specified endangered species. The goal of CITES is to control, reduce or eliminate international trade in species whose numbers or condition suggests that further removal from their natural habitat would be

detrimental to the species' survival. Nepal currently manages this international obligation through its National Parks and Wildlife Conservation Act, 1973.

The Natural History Museum and the Herbarium section of the Royal Botanical Garden are the scientific decision-making authorities under CITES for wild animals and plants. The Department of National Parks and Wildlife Conservation and the Department of Plant Resources have management authority for this purpose.

**Convention on Biological Diversity**
Nepal is signatory to this convention, which came into force in Nepal as of February 21, 1994. To fulfil this commitment, Nepal has been developing a national plan for biodiversity conservation and management, to identify and monitor biodiversity and establish a network of protected areas. Nepal is also attempting to include biodiversity as an essential component in environmental impact assessments.

**Agenda 21**
Nepal is implementing "Agenda 21," (Earth Summit, UN Conference on Environment and Development, held in Rio de Janeiro, Brazil, 1992) a non-binding international statement of goals and principles. It requests countries to promote activities that are well supported in Nepal, such as poverty alleviation, improved land use, conservation of biodiversity, public participation, empowerment of women, respect of indigenous cultures, and working with NGOs for the development of human resources which are well supported in Nepal.

**Forest Principles**
Nepal has accepted the non-binding United Nations Conference on Environment and Development (UNCED, Rio de Janeiro, Brazil, 1992) principles on forest regulation and management. These principles mainly require increased public participation, respect for indigenous cultures and rights, empowerment of women, comprehensive valuation of forests, sustainable management of natural forests, extension of forest cover, conservation of biodiversity and pre-project environmental assessment.
It is also worth noting at this stage, that adequate time must be set aside at the full ESIA stage for compliance with Nepal's IEE/EIA procedure. Because that procedure customarily runs for many months, it could have unanticipated impacts on the MCC project implementation timeline, and therefore represents a timing risk that should be incorporated into the appropriate project risk analysis. The detailed feasibility study (DFS) consultant will incorporate further guidance regarding compliance with Nepal as well as IFC E/S standards into the specifications for the full ESIA to be included in the DFS final report.

### 1.2.3 Gender Policy

Nepal has a robust policy base for addressing gender equality and has put structural mechanisms into place. Its Interim Constitution, 2007, prohibited discrimination based on sex and advocated special legal provisions to protect and advance the interests of women, stating that *"no physical, mental or any forms of violence shall be inflicted to any women, and such an act shall be punishable by law."* The 2015

Constitution followed in continuing progressive steps for women.[5] Violence against women based on any cultural, religious, or traditional practices was criminalized, men and women have been given equal property rights, and a quota was set that at least 33% of parliamentary members should be women. However, the Constitution has certain inconsistencies with CEDAW and continues to allow for discriminatory practices, such as in civil service benefits and not conferring citizenship rights to children of single mothers. Much of the controversy surrounding the new Constitution must do with proposed ethnic delineation of new provinces, which will also have significant gender implications. Much of recent political commentary draws attention to underlying discrimination against the Indigenous Peoples, in which the new Constitution has been "…. denounced … as racist … anti-indigenous peoples, anti-Madhesi, undemocratic … [and] … against international human rights standards, including UNDRIP…"[6], and the protests have been an attempt to "correct the course of history in which Madhesi and indigenous janajati groups were left out of power sharing and remained structurally marginalised"[7].

Nepal is a signatory to 23 human rights treaties and international human rights instruments that support women's rights and equality, including the Convention on All Forms of Discrimination Against Women, Beijing Platform for Action, the Millennium Development Goals, and various UN Security Resolutions on women in armed conflict and peacekeeping situations.[8] Nepal is the first Asian country to have developed a National Action Plan on Women, Peace and Security (2011), and the rights of women and girls are protected in the Comprehensive Peace Accord (2006). The Government has also established, as constitutional bodies, the National Women Commission and the National Dalit Commission to further strengthen the institutional and legislative basis for gender and caste equality. The three-year Human

[5] For example, "*No discrimination shall be made in the application of general laws on grounds of origin, religion, race, caste, tribe, sex, physical condition, condition of health, marital status, pregnancy, economic condition, language or region, ideology or on similar other grounds;" "The State shall not discriminate citizens on grounds of origin, religion, race, caste, tribe, sex, economic condition, language, region, ideology or on similar other grounds*; "*No discrimination shall be made on the ground of gender with regard to remuneration and social security for the same work*;" and, "*All offspring shall have the equal right to the ancestral property without discrimination on the ground of gender*. Constitution of Nepal. Part 3 (18.2, 18.3, 18.4, 18.5).

[6] IWGIA. Indigenous World. 2016

[7] The Wire. 21 July 2016. Refer also to Al-Jazeera, "Nepal's ethnic Madhesis fight for dignity and equality: People from the country's southern region say they will continue their struggle against domination by hill people." 5 April 2016.

[8] *Resolutions 1325* (2000), *1820* (2008), *1888* (2009), *1889 (*2009), *1960 (*2010) and *2106* (2013). *Resolution 1325*, adopted October 2000, calls for an increase in the participation of women and incorporation of gender perspectives in all United Nations peace and security efforts, as well as all parties to conflict to take special measures to protect women and girls from gender-based violence, particularly rape and other forms of sexual abuse, in situations of armed conflict. *Resolution 1820*, adopted June 2008, calls on all parties to armed conflict immediately take appropriate measures to protect civilians, including women and girls, from all forms of sexual violence, and reiterates the need to continue and strengthen efforts to implement the policy of zero tolerance of sexual exploitation and abuse in United Nations peacekeeping operation. UN Women. *Nepal Gender Profile 2015*. May 2015. UN Peacekeeping Operations website. http://www.un.org/en/peacekeeping/issues/women.

Rights National Plan of Action (2010/11-2012/13) has provisions to protect the rights of women and children.

Table 2. Gender-related Constitutional and Legal Provisions, and Operational Policies

| | |
|---|---|
| Constitutional Provisions | Interim Constitution of Nepal 2007; Constitution of Nepal 2015 |
| Legal Provisions | Country Code, 1963 |
| | Labor Act, 1991 |
| | Social Practices (Reform) Act, 1976 |
| | Libel and Slander Act, 1959 |
| | Some Public (Crime and Punishment) Act, 1970 |
| | Children Act, 1991 |
| | Police Act, 1955 |
| | Local Self-Governance Act, 1998 |
| | National Women Commission Act, 2006 |
| | National Women Commission Rules, 2006 |
| Special Laws | Domestic Violence (Offence and Punishment) Act, 2009 |
| | Domestic Violence (Offence and Punishment) Regulation. 2010 |
| | Human Trafficking and Transportation (Control) Act, 2007 |
| | Human Trafficking and Transportation (Control) Regulation, 2008 |
| | Gender Violence Elimination Fund (Operation) Rules, 2009 |
| Procedural Provisions | Country Code, 1963 |
| | State Cases Act, 1993 |
| | Supreme Court Regulation, 1992 |
| | District Court Regulation, 1995 |
| | Appellate Court Regulation, 1991 |
| | The Procedural Guidelines for Protecting the Privacy of the Parties in the Proceedings of Special Types of Cases, 2007 |
| | Standard Operating Procedure of Rehabilitation Centers, 2012 |
| | Guidelines for Regulating Women Workers in Dance, Bar, Cabin Restaurant, Massage Parlor, 2008 |
| Operational Guidelines | National Reconstruction and Rehabilitation Fund, 2015 |
| | The National Plan of Action Against Gender Based Violence, 2010 |
| | Five Year National Strategy and Action Plan to End Gender Based Violence (2012- 2016) |

Adapted from UN Women. *Progress of Women in Nepal (1995-2015).* 2015.

## 1.3 MCC Guidelines and IFC Environmental and Social Performance Standards

### 1.3.1 MCC Environmental Guidelines

MCC's Environmental Guidelines have been formulated to be used in environmental and social reviews of projects proposed in Compacts. The scope of the environmental and social review depends on the nature, scale, and potential environmental and social impacts of the proposed projects[9] While the required environmental and social impact analysis of projects is the responsibility of the host country under its laws and regulations and international agreements and conventions, MCC will provide advice and consultation on environmental and social impact assessment (ESIA) requirements. The findings and recommendations of the ESIA will be reviewed by MCC and it may request additional assessment, if required, to ensure their consistency with MCC guidelines.

While the objective of the Environmental Guidelines is to describe the principles of environmental and social impact assessment that Compact-eligible countries are expected to apply, MCC has adopted the IFC Performance Standards, which will also be used to ensure that Compact activities are implemented in compliance with, through its due diligence and implementation oversight of projects.

In the process of Compact proposal review MCC, will screen each project as described in these guidelines, as early as possible, and will base its funding decisions on the screening and analysis of the environmental and social impacts of the project when required.[10] Consequently, funding will not be provided by MCC for projects unless there is provision for appropriate screening and appropriate environmental and social impact analysis. And "MCC may not provide assistance for any project that is likely to cause a significant environmental, health, or safety hazard."[11]

All Compact proposals are screened by MCC to identify projects that require further review considering the potential adverse environmental and social impacts, and projects that are in sensitive sectors or in or near sensitive locations. This screening process will classify the Compact proposals as A, B, C or D, according to their potential environmental and social impacts, and the extent of the environmental and social review required.[12]

**Category A**
Projects with potential to have significant adverse environmental and social impacts that are sensitive, diverse, or unprecedented, and may affect an area broader than the sites or facilities of the project, are classified as Category A. In principle, Category A, includes projects in sensitive sectors or located in or

[9] MCC. 2010. Environmental Guidelines
[10] Ibid.
[11] Ibid.
[12] Ibid.

near sensitive areas, and a list of such sensitive sectors and locations is provided as Annex C to the guidelines. This list includes the construction of overhead electrical power lines.[13]

Category A projects will require an Environmental and Social Impact Assessment which should be initiated as early as possible in project development and must be integrated closely with the economic, financial, institutional, social, and technical analyses of proposed project. MCC guidelines specify that an "Environmental and Social Impact Assessment should take into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples and cultural property); natural disaster risk and vulnerability assessment; and transboundary and global environmental aspects."[14]

**Category B**
Projects in which the impacts are site-specific, few if any of them are irreversible, and mitigation measures are more readily available, are classified Category B. As per the guidelines, Category B projects will require appropriate specific environmental and social impact analyses such as Environmental and Social Management Plans.

**Category C**
If a project is unlikely to have adverse environmental and social impacts, it falls in Category C and as per the Guidelines, an environmental and social impact analysis will not be a requirement. However, MCC may request for specific environmental and social impact studies, reporting, or training where relevant.

**Category D**
Projects that involve an intermediate facility, such as a municipal public grant fund, that will use MCC funding to finance subprojects that may potentially result in adverse environmental and social impacts is classified under Category D. The sub-projects in this case will have to comply with the environmental and social analysis required under the laws and regulation of the host country.

MCC Guidelines also specifies that project implementing agencies should implement timely, participatory, and meaningful public consultation in the process of developing the Environmental and Social Impact Assessments and associated Management Plans, and public disclosure of these documents.

Monitoring and reporting are also an important requirement of the Guidelines. While the host country is required to conduct appropriate monitoring of project mitigation plans, it is also the responsibility of the host country to report regularly to MCC, describing how the activities funded under the Compact are being carried out in compliance with the guidelines and the environmental and social requirements described in the Compact and related documents.

[13] Ibid. Appendix C: Illustrative List of Sensitive Sectors and Sensitive Locations.
[14] Ibid., p. 5.

### 1.3.2 MCC Social and Gender Policies

The principal MCC policies and guidelines relevant to social and gender assessment being carried out to support the PESIA are:

- Compact Development Guidance (2013)
  - *Social and Gender Assessment*
  - *Guidelines for Economic and Beneficiary Analysis*
  - *Environmental and Social Assessment of Projects Proposed During Compact Development*
- *Gender Policy* (2006)
- *Gender Integration Guidelines* (2011)
- *Principles into Practice: Gender Equality and Poverty Reduction Through Growth* (2012)
- *Issue Brief: Unwrapping MCC's Gender Indicators (2015)*
- *Environmental Guidelines* (2010)
- *Counter-Trafficking in Persons Policy* (2016)
- *Health and Safety Policy* (2010)
- *Policy on Monitoring and Evaluation* (2012).

This effort is also guided by IFC's Policy on Environmental and Social Sustainability (2012), which includes Performance Standards that MCC adopted and will be applied in compact development and project/program implementation. IFC Guidance Notes for the Performance Standards provide further clarification on application of the Standards.

### 1.3.3 IFC Performance Standards

IFC's Sustainability Framework comprises IFC's Policy and Performance Standards on Environmental and Social Sustainability[15], which describe the commitments, roles, and responsibilities of IFC in relation to environmental and social sustainability.

The Performance Standards are designed to help avoid, mitigate, and manage risks ensuring sustainability, and provide guidance to clients on how to identify risks and impacts. When funding is provided by IFC, the corporation requires its clients to apply the Performance Standards to manage environmental and social risks and impacts to enhance development opportunities.

Eight Performance Standards has been established by IFC which the clients are required to follow throughout the life of an investment by IFC. These standards are:

[15] http://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/IFC+Sustainability/Our+Approach/Risk+Management/Performance+Standards

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts
- Performance Standard 2: Labor and Working Conditions
- Performance Standard 3: Resource Efficiency and Pollution Prevention
- Performance Standard 4: Community Health, Safety, and Security
- Performance Standard 5: Land Acquisition and Involuntary Resettlement
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- Performance Standard 7: Indigenous Peoples
- Performance Standard 8: Cultural Heritage.

In Performance Standard 1, IFC establishes the need for 1) integrated assessment conducted to identify the environmental and social impacts, risks, and opportunities of projects, 2) effective community engagement through consultation with and disclosure of project-related information to local communities; and 3) the client's management of environmental and social performance throughout the life of the project.

Performance Standards 2 through 8 describe objectives and requirements to avoid, minimize, and where residual impacts remain, to compensate/offset for risks and impacts to workers, affected communities, and the environment. While all relevant environmental and social risks and potential impacts should be considered as part of the assessment process, Performance Standards 2 through 8 incorporate the potential environmental and social risks and impacts that need attention.

When project-related environmental or social risks and impacts are identified, the client will have to manage them through its Environmental and Social Management System complying with Performance Standard 1.[16] While Performance Standard 1 will apply to all projects having potential environmental and social risks and impacts, other Performance Standards may have to be applied, depending on project circumstances.

In the application of IFC Performance Standards, cross-cutting topics such as climate change, gender, human rights, and water, are addressed across multiple Performance Standards. Further, Clients are also required to comply with applicable national law, including those laws implementing host country obligations under international law, in addition to meeting the requirements under the Performance Standards.

**Performance Standard 1** emphasizes the importance of managing environmental and social performance throughout the life of a project. The main objectives[17] of Performance Standard 1 are to:

[16] IFC. 2012. IFC Performance Standard 1 Assessment and Management of Environmental and Social Risks and Impacts

[17] IFC. 2012. IFC Performance Standard 1 Assessment and Management of Environmental and Social Risks and Impacts

- Identify and assess environmental and social risks and impacts of the project
- Adopt a mitigation hierarchy to anticipate and avoid or minimize, or, compensate/offset for risks and impacts to workers, affected communities, and the environment
- Facilitate improved environmental and social performance of clients through the effective use of management systems
- Ensure that grievances from affected communities and other stakeholders are managed appropriately through a grievance redress mechanism
- Promote and facilitate adequate engagement with affected communities throughout the project cycle to ensure that relevant environmental and social information is disclosed and disseminated.

Performance Standard 1 establishes the need for the client, to conduct an environmental and social assessment, and establish and maintain an Environmental and Social Management System (ESMS) appropriate to the nature and scale of the project and its level of environmental and social risks and impacts. The ESMS is required to incorporate:

- The policy defining the environmental and social objectives and principles
- A process for identifying the environmental and social risks and impacts of the project
- A management programs that, in sum, will describe mitigation and performance improvement measures and actions that address the identified environmental and social risks and impacts of the project
- An organizational structure that defines roles, responsibilities, and authority to implement the ESMS
- An emergency preparedness and response system so that the client, in collaboration with appropriate and relevant third parties, will be prepared to respond to accidental and emergency situations associated with the project
- Stakeholder analysis and planning, disclosure and dissemination of information, consultation and participation, grievance mechanism, and ongoing reporting to affected communities
- Procedures to monitor and measure the effectiveness of the management program, as well as compliance with any related legal and/or contractual obligations and regulatory requirements;

**Performance Standard 2** establishes that the pursuit of economic growth through employment and income generation should be attended by the protection of the fundamental rights of the workers. The requirements in this Standard have been partly guided by a number of international conventions and instruments. The objectives[18] of the Standard are to:

- Promote the fair treatment, non-discrimination, and equal opportunity of workers

[18] Guidance Note 2 Labor and Working Conditions.
http://www.ifc.org/wps/wcm/connect/0d7a4480498007faa1f7f3336b93d75f/Updated_GN2-2012.pdf?MOD=AJPERES

- Establish, maintain, and improve the worker-management relationship
- Promote compliance with national employment and labor laws
- Protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain
- Promote safe and healthy working conditions, and the health of workers
- Avoid the use of forced labor.

**Performance Standard 3** recognizes that increased economic activity and urbanization are often associated with the generation of increased levels of pollution to air, water, and land, and utilize finite resources in a manner that may threaten people and the environment at the local, regional, and global levels.[19] Therefore, the objectives[20] of the Standard are to: Avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities, promote more sustainable use of resources, including energy and water, and reduce project-related GHG emissions.

**Performance Standard 4** recognizes that project activities, equipment, and infrastructure could enhance community exposure to risks and impacts. Acknowledging the public authorities' role in promoting the health, safety, and security of the public, this Standard defines the client's responsibility to avoid or minimize the risks and impacts to community health, safety, and security that may arise from project related-activities, with attention to vulnerable groups.

The objectives of the Performance Standard are to anticipate and avoid adverse impacts on the health and safety of the affected community during the project life from both routine and non-routine circumstances, and ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the affected communities.[21]

**Performance Standard 5** establishes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use the land. Project-related land

[19] Guidance Note 3 Resource Efficiency and Pollution Prevention. http://www.ifc.org/wps/wcm/connect/9187330049800a6baa9cfa336b93d75f/Updated_GN3-2012.pdf?MOD=AJPERES. Accessed 25Nov2016

[20] Guidance Note 3 Resource Efficiency and Pollution Prevention. http://www.ifc.org/wps/wcm/connect/9187330049800a6baa9cfa336b93d75f/Updated_GN3-2012.pdf?MOD=AJPERES. Accessed 25Nov2016

[21] Guidance Note 4 Community Health, Safety and Security. http://www.ifc.org/wps/wcm/connect/dc3f4b80498007dca17ff3336b93d75f/Updated_GN4-2012.pdf?MOD=AJPERES. Accessed 25Nov2016

acquisition/restrictions on land use lead to physical or economic displacement, which entails involuntary resettlement. Thus, the objectives[22] of this performance Standard are to:

- Avoid, and when avoidance is not possible, minimize displacement, by exploring alternative project designs
- Avoid forced eviction
- Anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by providing compensation for loss of assets at replacement cost
- Ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected
- Improve, or restore, the livelihoods and standards of living of displaced persons.

**Performance Standard 6** recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. This Performance Standard has been guided by the Convention on Biological Diversity, which defines biodiversity as the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems.[23]

The objectives of the Standard target the protection and conservation biodiversity, maintaining the benefits from ecosystem services and promoting sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

**Performance Standard 7** recognizes that indigenous peoples, as social groups with identities that are distinct from mainstream groups, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development.[24]

The objectives of this Performance Standard are to:

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[22] Guidance Note 5 Land Acquisition and Involuntary Resettlement. http://www.ifc.org/wps/wcm/connect/4b976700498008d3a417f6336b93d75f/Updated_GN5-2012.pdf?MOD=AJPERES. Accessed 25Nov2016

[23] Guidance Note 6 Biodiversity Conservation and Sustainable Management of Living Natural Resources. http://www.ifc.org/wps/wcm/connect/a359a380498007e9a1b7f3336b93d75f/Updated_GN6-2012.pdf?MOD=AJPERES. Accessed 25 Nov 2016

[24] Guidance Note 7 Indigenous Peoples. http://www.ifc.org/wps/wcm/connect/50eed180498009f9a89bfa336b93d75f/Updated_GN7-2012.pdf?MOD=AJPERES. Accessed 25 Nov 2016

- Ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of indigenous peoples
- Anticipate and avoid adverse impacts of projects on communities of indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts
- Promote sustainable development benefits and opportunities for indigenous peoples in a culturally appropriate manner
- Establish and maintain an ongoing relationship based on informed consultation and participation with the indigenous peoples affected by a project throughout the project's life-cycle
- Ensure the free, prior, and informed consent of the affected communities of indigenous peoples when the circumstances described in this Performance Standard are present
- Respect and preserve the culture, knowledge, and practices of indigenous peoples.

**Performance Standard 8** recognizes the importance of cultural heritage for current and future generations. Complying with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to ensure that clients protect cultural heritage in implementing their project activities.

The objectives of the Standard aimed at protecting cultural heritage from the adverse impacts of project activities and support its preservation, and promoting the equitable sharing of benefits in the use of cultural heritage. [25]

## 1.4 Comparison of IFC Performance Standards and National and Local Law and Regulations

Table 3 compares Nepal environmental standards and regulations to the IFC performance standards, and suggests areas where there are gaps between them and how to address the gaps.

[25] Guidance Note 8 Cultural Heritage. http://www.ifc.org/wps/wcm/connect/39e39000498007fda1fff3336b93d75f/Updated_GN8-2012.pdf?MOD=AJPERES. Accessed 25 Nov 2016

Table 3. Comparison of IFC Performance Standards with National and Local Laws and Regulations

| IFC Performance Standards (PS) | Applicable Nepal law/regulations | Gaps | How to fill the gaps for this project |
|---|---|---|---|
| **PS Standard 1**: **Assessment and Management of Environmental and Social Risks and Impacts**:<br>a. Identify and assess environmental and social risks and impacts of the project;<br>b. Adopt a mitigation hierarchy to anticipate and avoid or minimize, or, compensate/offset for risks and impacts to workers, Affected Communities, and the environment; | The Constitution of Nepal[26];<br>That Environment Protection Act (EPA)[27], 1997;<br>Environment Protection Rules (EPR), 1997;<br>Operational Manual of Environmental Social Impact Assessment (EIA/SIA) for Sub-Projects Financed Under the Additional Financing of the Power Development<br>Project, Revised April, 2009 | The GoN environmental assessment technical requirements are considered to be virtually compatible with World Bank, ADB, IFC PS requirements in respect of environment issues. However, it has been noted that Nepal Electricity Authority (NEA) is weak on undertaking alternatives analysis especially with regard to transmission lines[28] even though Environmental Protection Rules (EPR) 1997, Schedule 6 defines as Item 7 the EIA content to include: Analysis of alternatives for the proposal:<br><br>Recent amendments to the EPR 1997 (3rd amendment May 2013) reduced the threshold for EIA requirement for TLs - transmission lines of any size only require IEE level of environment assessment under GoN law unless passing | Chapter 4: Alternative analysis section of the Operational Manual of Environmental Social Impact Assessment (EIA/SIA) for Sub-Projects Financed Under the Additional Financing of the Power Development Project should be emphasized and Alternative analysis will be included as a requirement in the TOR for the ESIA of the Project.<br><br>To avoid weakening of Environmental assessment |

[26] The Constitution of Nepal. 2015. Clause 4 of Article 26: The State shall give priority to the protection of the environment and also to the prevention of its further damage due to physical development activities by increasing the awareness of the general public about environmental cleanliness and the State shall also make arrangements for the special protection of the rare wildlife, the forests and the vegetation;

[27] The Environment Protection Act makes impact assessment mandatory for major development projects. The EPA provides the legal basis for the relevant authorities to require an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) for all projects with potentially negative impacts on the environment.

[28] Alan Sewell, Hilary Byrne, Bhavin Vyas. 19-Jul-2016. Memorandum. TD1 Task 1 Deliverables (1) memo outlining weaknesses in existing policies and legislation and outlining options and opportunities for strengthening ESMS, resettlement and stakeholder engagement and outlining next steps in a strategy matching compact development, entry into force and implementation stages.

Table 3. Comparison of IFC Performance Standards with National and Local Laws and Regulations

| IFC Performance Standards (PS) | Applicable Nepal law/regulations | Gaps | How to fill the gaps for this project |
|---|---|---|---|
| c. Facilitate improved environmental and social performance of clients through the effective use of management systems | | through a National Park or involving resettlement of more than 100 people.[29]<br><br>The monitoring functions are spread among different agencies as provided for in the respective legislation. Much of the legislation has not been adequately designed, nor properly supplemented with supporting regulations. Hence, the monitoring work is weak and, in many cases, non-existent. | process by the 3rd amendment to EPR 1997, MCC shall require the preparation of an ESIA as per IFC Performance Standards.<br><br>An Environmental Monitoring Plan for implementation during and after construction shall be a part of the ESIA and the TOR for the ESIA should specify the requirement. |
| d. Ensure that grievances from Affected Communities and other stakeholders are managed appropriately through a grievance redress mechanism | Required under Section 8.8 Institutional Arrangement of the Operational Manual of Environmental Social Impact Assessment (EIA/SIA) for Sub-Projects Financed Under the Additional Financing of the Power Development Project, Revised April, 2009 | Notwithstanding that Grievance Redress Mechanism (GRM) is not provided in EPR 1997, it is included as a requirement in Operational Manual of Environmental Social Impact Assessment (EIA/SIA) for Sub-Projects Financed Under the Additional Financing of the Power Development Project, prepared and adopted by National Electricity Authority of Nepal. | GRM should be included in the TOR for the ESIA of the Project. |
| e. Promote and facilitate adequate engagement with | EPA, 1977;<br>EPR, 1997[30]; | Although the *Operational Manual of Environmental Social Impact Assessment (EIA/SIA) for Sub-Projects Financed* | To ensure adequate engagement with affected communities, |

[29] Ibid.

Table 3. Comparison of IFC Performance Standards with National and Local Laws and Regulations

| IFC Performance Standards (PS) | Applicable Nepal law/regulations | Gaps | How to fill the gaps for this project |
|---|---|---|---|
| Affected Communities throughout the project cycle to ensure that relevant environmental and social information is disclosed and disseminated | Required under sections 5.2 Scoping Process, 5.4 Public Consultation and 8.10 Public Disclosure, Consultation and Participation Operational Manual of Environmental Social Impact Assessment (EIA/SIA) for Sub-Projects Financed Under the Additional Financing of the Power Development Project, Revised April, 2009 | *Under the Additional Financing of the Power Development Project,* includes stakeholder consultation, engagement with communities throughout the life cycle, to facilitate the affected communities to be heard, understood, and considered in project decisions and creation of development benefits, is not adequately addressed. | stakeholder engagement should follow the Stakeholder Engagement Framework (SEF) developed during compact development. |
| **2: Labor and Working Conditions** | The Labour Act, (1992)<br>Child Labour (Prohibition and Regulation) Act, 2000<br>Trade Union Act, 2049 (1992)<br>Labour Rules, 1993 | Enforcement of Regulations is not very successful due to the weak regulatory System. | Strengthening the authority and number of Labor Officers and Factory Inspectors, and making their services available to all sectors will ensure Labor and Working conditions are optimal.<br><br>The TOR for ESIA should include recommending measures for |

[30] EPR, 1997 further elaborates on the public consultation process in order to ensure the participation of different stakeholders from initial scoping to final approval. The EPR also obliges the proponent to issue a public notice on the contents prior to the preparation of a scoping report. Once the draft EIA report is prepared, based on the approved Terms of Reference (TOR), the proponent should conduct a Public Hearing at the project site. Following submission of the EIA report to the Ministry of Population and Environment, it should be made public.

Table 3. Comparison of IFC Performance Standards with National and Local Laws and Regulations

| IFC Performance Standards (PS) | Applicable Nepal law/regulations | Gaps | How to fill the gaps for this project |
|---|---|---|---|
| | | | ensuring that working conditions for labor in the implementation of the Project are consistent with PS 2 |
| **3: Resource Efficiency and Pollution Prevention** | Section 7 of EPA, 1977[31]<br><br>Chapter 3 of EPR, 1977[32];<br><br>Solid Waste Management and Resource Mobilization Act, 1987;<br><br>Solid Waste Management Act, 2011 and Rules, 2013<br><br>Local Self Governance Act, 1999 | Except for the Solid Waste Management and Resource Mobilization Act, rest of the other Acts and Rules are primarily concerned with regulating the structure, duties and functions of different institutions;<br>Work on resource reuse and efficiency<br>Hazardous Wastes (HW) has not been given its due importance and there has been no policy, legislation, standards for HW as such.[33]<br>Further, there is no monitoring and enforcement system.<br>Industrial Pollution Control Management Project and Environment Sector Programme Support has promoted Cleaner Production, Energy Efficiency and Environmental Management. However, many industries have not | Effective monitoring and enforcement of the policy measures will minimize the contamination of the natural environmental resources and clean up the already polluted water bodies, unhealthy contamination of the Municipal Solid Waste and toxic releases to the atmosphere.[35]<br><br>The TOR prepared for the ESIA of the project should specify that |

[31] Section 7 of EPA refers to pollution control, which states "A person shall not cause pollution or allow pollution to be caused in a manner which is likely to have significant adverse impact on the environment or harm human life or public health or shall not emits, discharge sound, heat, radioactive from any machine, industrial enterprises or any other place above the prescribed standard

[32] EPR, 1997 has provided various provisions under rules 15 to 20 for preventing and controlling pollution. These provisions include stopping emission and discharging solid waste against the standards (rule 15) to install and maintain properly the equipment or treatment plants (rule 16)

[33] RETA 6361. 2010, REG Managing Hazardous Wastes Nepal Hazardous Waste Policy Study Report

Table 3. Comparison of IFC Performance Standards with National and Local Laws and Regulations

| IFC Performance Standards (PS) | Applicable Nepal law/regulations | Gaps | How to fill the gaps for this project |
|---|---|---|---|
| | | internalized these preventive approaches due to lack of monitoring and enforcement of the environmental rules.[34] | measures for resource efficiency and pollution prevention should be recommended in the ESIA. |
| **4: Community Health, Safety, and Security** | The 1999 Local Self Governance Act aimed to include devolution of basic services such as health, drinking water and rural infrastructure. | There are no regulations or standards that define the client's/contractors' responsibility to avoid or minimize the risks and impacts to community health, safety, and security that may arise from project related-activities, except EPA.1977 which provides for preparation of EIA/IEE where impacts on community health, safety, and Security has to be considered. | The TOR for the ESIA of the Project should specify that measures for ensuring community health, safety and security should be recommended to be followed both during construction and operation. |
| **5: Land Acquisition and Involuntary Resettlement** | Resettlement in Nepal is managed through the existing Land Acquisition Act (LAA) of 1977, for which Government of Nepal (GoN) guidelines exist for implementation. These have been applied patchily and not always in full and very often not within the spirit of the legislation. The Act defines what and | LAA, 1977 does not specify that the compensation must be at market value.<br>Although the Act defines what and how land acquisition should cover, including structures, it does not cover replacement of livelihoods or community consultation.[36]<br><br>The LAA makes no reference to surveys required for the MOPE implementation of the Environmental Protection Act or other Acts and is therefore vulnerable to interpretation | TOR for Resettlement Action Plan (RAP) for the Project should ensure that the RAP Entitlement matrix incorporate:<br>i) compensation at market rate;<br>ii) cover livelihoods and community consultation; and,<br>iii) grievance redress mechanism;<br>as per IFC Performance Standard |

[35] Ibid.

[34] RETA 6361. 2010, REG Managing Hazardous Wastes. Nepal Hazardous Waste Policy Study Report.

[36] Alan Sewell, Hilary Byrne, Bhavin Vyas. 19-Jul-2016. Memorandum. TD1 Task 1 Deliverables (1) memo outlining weaknesses in existing policies and legislation and outlining options and opportunities for strengthening ESMS, resettlement and stakeholder engagement and outlining next steps in a strategy matching compact development, entry into force and implementation stages

Table 3. Comparison of IFC Performance Standards with National and Local Laws and Regulations

| IFC Performance Standards (PS) | Applicable Nepal law/regulations | Gaps | How to fill the gaps for this project |
|---|---|---|---|
| | how land acquisition should cover including structures but does not cover replacement of livelihoods or community consultation or special measures for indigenous peoples. | and bypass when expedient. The current MoE practice is to try and use the IEE process rather than triggering a full EIA[37] to save time and money.[38]<br><br>Does not deal with loss of future land value increases; compensation for land under the TL is effectively a land rental payment for loss of amenity and potential land use. The land is not acquired but is given a restriction on land use. Currently 10% land value is ascribed but APs reject this as too little – issue is highly politicized.[39]<br><br>The GoN grievance redress process in resettlement is generally reduced to complaining to the Chief District Officer/ District development Committees or Village | 5.<br>Further, RAP should also address the impacts on host communities. |

[37] Alan Sewell, Hilary Byrne, Bhavin Vyas. 19-Jul-2016. Memorandum. TD1 Task 1 Deliverables (1) memo outlining weaknesses in existing policies and legislation and outlining options and opportunities for strengthening ESMS, resettlement and stakeholder engagement and outlining next steps in a strategy matching compact development, entry into force and implementation stages.

[38] Existing regulations currently require an EIA where more than 100 people are affected. The MoE and NEA have either ignored this trigger or defined affected as losing household structures rather than a wider definition of Project Affected Peoples (PAPs) used by international donors. e.g., A Community Forest User group is deemed not to count as no structures are to be lost, areas underneath high tension lines may not force household relocation only restriction of activities and so are deemed not to count.

[39] Alan Sewell, Hilary Byrne, Bhavin Vyas. 19-Jul-2016. Memorandum. TD1 Task 1 Deliverables (1) memo outlining weaknesses in existing policies and legislation and outlining options and opportunities for strengthening ESMS, resettlement and stakeholder engagement and outlining next steps in a strategy matching compact development, entry into force and implementation stages

Table 3. Comparison of IFC Performance Standards with National and Local Laws and Regulations

| IFC Performance Standards (PS) | Applicable Nepal law/regulations | Gaps | How to fill the gaps for this project |
|---|---|---|---|
| | | Development Committees rather than following a formal process.[40] | |
| **6: Biodiversity Conservation and Sustainable Management of Living Natural Resources** | Forest Act, 1993, Water Resources Act, 1992<br>International Centre for Integrated Mountain Development Act, 1983; King Mahendra Trust for Nature Conservation Act, 1982; Soil Conservation and Watershed Management Act, 1982<br>National Parks and Wildlife Conservation Act, 1973; Plants Protection Act, 1972<br>Aquatic Animals Protection Act, 1961<br>Wildlife Protection Act, 1957<br>Forest Protection Act 1956<br>Ancient Monuments Protection Act, 1956 | The absence of a permanent system for generating and maintaining, on a regular basis, basic data on various aspects related to the environment is a serious problem in Nepal. A unified system does not exist under which relevant data can be generated on principal natural resources such as land, water, forests and biodiversity, and changes occurring in their use over time. Similarly, data systems do not exist either on the extent of untreated toxic effluent discharges into the natural system or the effects of such discharges on ecosystems and human health.[41]<br><br>Enforcement of existing provisions with regard to the environment is minimal, except in the case of the Department of National Parks and Wildlife Conservation and the Department of Forests, which have traditionally carried out some policing work in order to prevent and | The TOR for ESIA of the Project should ensure that measures for generating and maintaining basic data on biodiversity during and after the construction phase of the Project on a regular basis should be recommended.<br><br>The ESMP for the Project prepared during the ESIA process should incorporate measures to facilitate existing provisions with regard to biodiversity conservation and enhancement and monitoring. |

[40] Alan Sewell, Hilary Byrne, Bhavin Vyas. 19-Jul-2016. Memorandum. TD1 Task 1 Deliverables (1) memo outlining weaknesses in existing policies and legislation and outlining options and opportunities for strengthening ESMS, resettlement and stakeholder engagement and outlining next steps in a strategy matching compact development, entry into force and implementation stages

[41] UNEP-SACEP. 2001.Law Handbook, Nepal. Environmental legislation and institutions in Nepal

Table 3. Comparison of IFC Performance Standards with National and Local Laws and Regulations

| IFC Performance Standards (PS) | Applicable Nepal law/regulations | Gaps | How to fill the gaps for this project |
|---|---|---|---|
| | | contain forestry encroachment and the poaching of wildlife, respectively.[42] | |
| **7: Indigenous Peoples** | Operational Manual of Environmental Social Impact Assessment (EIA/SIA) | Although the LAA, 1977, defines what and how land acquisition should cover, including structures, it does not cover community consultation or special measures for indigenous peoples.[43]<br><br>Notwithstanding that GoN has ratified the ILO Convention 169 on indigenous peoples, there is no specific process for additional consultation of IPs, primarily because they do not have specific homelands and because their economic status tends to reflect that of the wider population of Nepal[44] | The TOR for ESIA for the Project should ensure that the Environmental Planning process should include preparation of an Indigenous Peoples Plan (IPP), if required; as per IFC Performance Standard 7. |
| **8: Cultural heritage** | Part IV, of Article 19(3) the Constitution of Nepal;<br>Environmental Protection Rules, 1977;<br>Ancient Monument Preservation Act, 1956 AD | The protection of physical cultural resources encountered during implementation of development projects are not mentioned, specifically, in the Ancient Monument Preservation Act, 1956. Protection of intangible cultural heritage is also not mentioned. | The Government of Nepal may frame Rules for implementing the objectives of the Ancient Monument Preservation Act, in the long term.<br>The TOR for ESIA of the Project |

[42] Ibid

[43] The IP situation in Nepal is that currently 37% population are classed as IPs but they are widely dispersed through the population, have no specific protected areas and have similar economic status to non IP populations.

[44] Alan Sewell, Hilary Byrne, Bhavin Vyas. 19-Jul-2016. Memorandum. TD1 Task 1 Deliverables (1) memo outlining weaknesses in existing policies and legislation and outlining options and opportunities for strengthening ESMS, resettlement and stakeholder engagement and outlining next steps in a strategy matching compact development, entry into force and implementation stages

Table 3. Comparison of IFC Performance Standards with National and Local Laws and Regulations

| IFC Performance Standards (PS) | Applicable Nepal law/regulations | Gaps | How to fill the gaps for this project |
|---|---|---|---|
| | | | should specify that measures for protection of cultural heritage resources such as physical cultural resources and intangible cultural resources should be incorporated in the ESIA. |

# 2. Project Description

## 2.1 Proposed Projects

The proposed projects under consideration for the Nepal Compact are shown in Figure 1 and Table 4.

Table 4. Proposed Projects

| No. | Project Components |
|---|---|
| 1 | NR1: 400kV Transmission Line total 270 km<br>Lapsiphedi to Naubise = 48 km<br>Naubise to New Hetauda = 41 km<br>Naubise to New Damauli = 98 km<br>New Damauli to New Butwal = 84 km<br>Lapsiphedi Substation<br>Naubise Substation<br>New Damauli Substation<br>New Butwal Substation<br>New Hetauda Substation |
| 2 | XB1: 400kV Transmission Line 23 km<br>New Butwal – Nepal/ India Border |
| 3 | T8: 400kV Transmission Line 47 km<br>New Lamki – Nepal/ India Border<br>New Lamki Substation |
| 4 | T3: 220kV Transmission Line 30 km<br>Tadhekani to Kusma<br>Tadhekani Substation |
| 5 | T2': 220kV Transmission Line 30 km<br>Likhu Hub to New Khimti<br>Likhu Hub Substation |
| 6 | NR3: 132kV Transmission Line 110 km<br>Ilam to Inaruwa |
| 7 | NR4: 132kV Transmission Line 131 km<br>Balanch to Attariya |

In addition to the transmission lines and substations, the projects will require the construction of several access roads. These are generally short links to existing roads, except in the cases of Tadhekani and possibly Likhu Hub. Because other developers are active in some of the same locations as the proposed MCC projects, not all these roads are the responsibility of the MCC Compact program, as shown in Table 5.

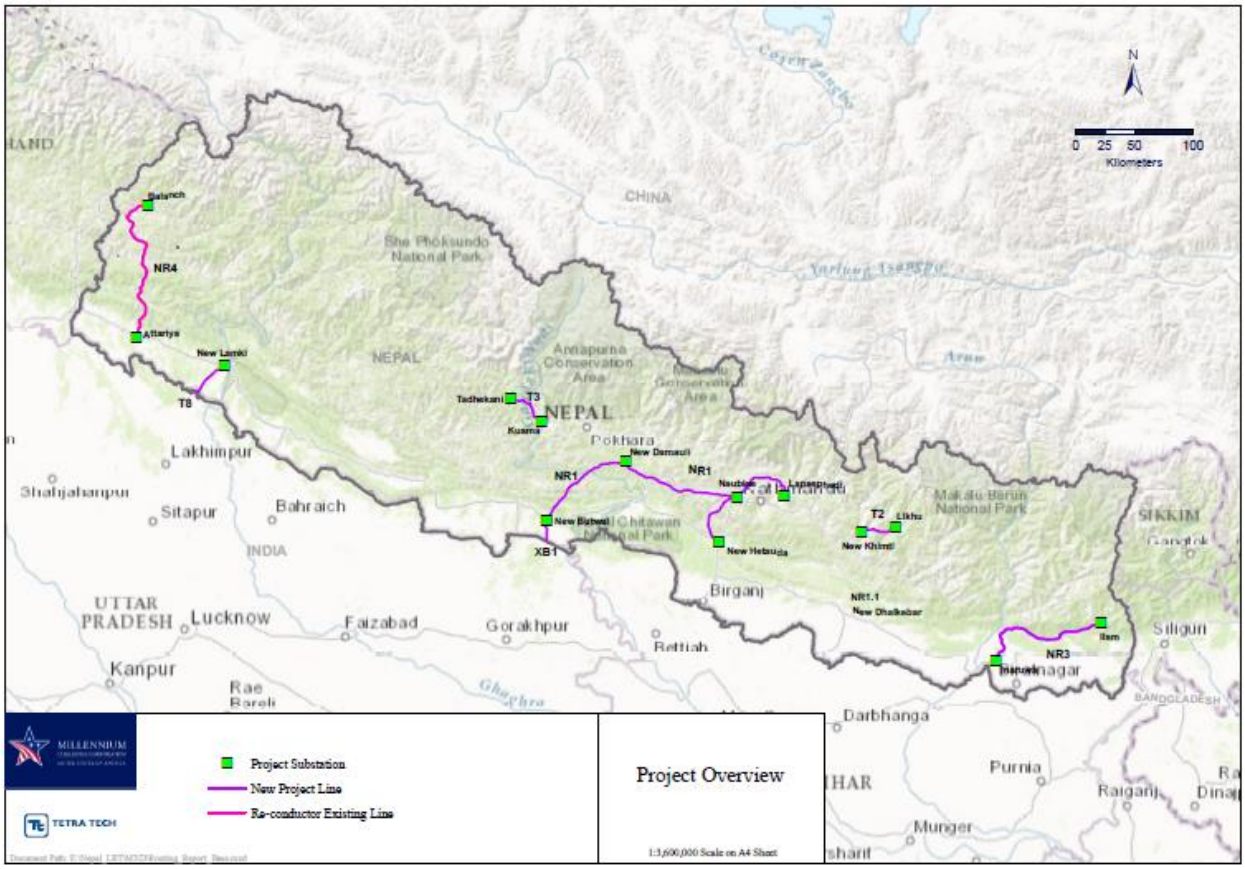


**Figure 1. Project Overview**

**Table 5.** Substation Access Road Information (as of December 2016)

| Substation | New access roads total length required (regardless of funding source) (km) | Segment of new road that is the responsibility of the MCC projects (km) | Donor / funding source; responsibility for road environmental assessment | Remarks |
|---|---|---|---|---|
| Lapsiphedi | 5.0 | 0 | ADB | |
| Naubise | 1.6 | 1.6 | MCC | |
| New Damauli | 0.45 | 0.45 | MCC | |
| New Butwal | 0.15 | 0.15 | ADB | |
| Tadhekani | 19.8 | 19.8 | MCC | 60 m bridge required |
| Likhu Hub | 0.45 | 0 | IPPs | |
| New Lamki | 0 | 0 | | Access is from existing main road |
| New Hetauda | 0.2 | 0.2 | World Bank | |
| **Totals** | **27.65** | **22.00** | | |

These roads are generally paved and one will require a 60 m long bridge with the capacity to handle trucks carrying heavy equipment. No roads are expected to be built to access the tower sites, although temporary passage may be required across some agricultural land. The towers will be built at their sites, and materials and equipment are expected to be brought to the sites by porters or mules in the less accessible areas.

Several of the transmission lines will serve specific power generation facilities that are considered to be "directly associated facilities,"[45] and whose potential environmental and social impacts may need to be considered. These lines and facilities are enumerated in Table 6.

**Table 6. Directly Associated IPP Facilities**

| Transmission Line | Associated facility | Capacity (MW) | Estimated Completion Date |
|---|---|---|---|
| T8 | Upper Karnali project | 900 | 2023 |
| T3 | Upper Myagdi (Hydro Empire Ltd) | 20 | 2021 |
| T3 | Ghar Khola (Myagdi Hydropower) | 8.3 | 2020 |
| T3 | Darbyang-Myagdi ( Dhaulagiri Hydro-power) - | 25 | 2019 |
| T3 | Upper Rahughat | 48.5 | 2028/ 2029* |
| T3 | Upper Myagdi -1 | 80 | 2028/ 2029* |
| T3 | Rahugaht Mangale | 37 | 2028/ 2029* |
| T3 | Tadekhani | 5 | 2028/ 2029* |
| T3 | Bagar Khola | 7.1 | 2028/ 2029* |
| T2' | Nupche Likhu (NEA) | | |
| T2' | Likhu-1 | 77 | |
| T2' | Likhu-2 | 55 | |
| T2' | Likhu A | 24.2 | |
| T2' | Buku-Kapati | 5 | |
| T2' | Likhu B | 47.4 | |
| T2' | Likhu Khola | 30 | |
| T2' | Likhu-4 | | |
| T2' | Lower Likhu | 28.1 | |
| T2' | Likhu A HPP (NEA) | 5 | |

* The completion dates are not known for these facilities as they are under study. But a date of 2028/ 2029 has been used for Master Plan study by NEA

[45] According to IFC PS1, impacts need to be assessed over the project's area of influence which includes: "Associated facilities, which are facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable.
[footnote] Associated facilities may include railways, roads, captive power plants or transmission lines, pipelines, utilities, warehouses, and logistics terminals."

With respect to NEA facilities under construction or planned, Table 7 shows the relative strength of the relationship of each facility to the MCC lines according to information received from NEA[46]. Relationships to individual lines are not available at this time, but those facilities with a qualitatively "strong" relationship to the MCC proposed lines should be investigated in the ESIA to ensure that their impacts are considered. This is especially important because there is no sectoral environmental assessment that relates all of these associated facilities (and the MCC proposed lines) in the context of all other power sector work.

Table 7. Relationship of NEA Planned Facilities to MCC Proposed Lines

| Under Construction | | Capacity(kW) | Relationship to MCC Lines |
|---|---|---|---|
| 1 | Upper Tamakoshi Hydropower Project | 456,000 | Strong |
| 2 | Tanahu Hydropower Project | 140,000 | |
| 3 | Chameliya HEP | 30,000 | strong |
| 4 | Kulekhani III HEP | 14,000 | medium |
| 5 | Upper Trishuli 3A HEP | 60,000 | medium |
| 6 | Rahughat HEP | 40,000 | strong |
| 7 | Upper Sanjen | 14,600 | medium |
| 8 | Sanjen | 42,500 | medium |
| 9 | Rasuwagadi | 111,000 | medium |
| 10 | Madhya Bhotekoshi | 102,000 | strong |
| 11 | Upper Trishuli 3B | 37,000 | medium |
| **Planned and Proposed** | | | |
| 1 | Upper Arun HEP | 335,000 | weak |
| 2 | Upper Modi A HEP | 42,000 | weak |
| 3 | Upper Modi HEP | 18,200 | weak |
| 4 | DudhKoshi Storage HEP | 640,000 | weak |
| 5 | Tamor Storage HEP | 530,000 | weak |
| 6 | Uttar Ganga Storage HEP | 300,000 | weak |
| 7 | Tamakoshi V HEP | 87,000 | strong |
| 8 | Upper Bheri HEP | 85,000 | weak |
| 9 | Chainpur Seti HEP | 140,000 | weak |

Additional descriptions of the projects and how the routing was carried out are found in the sections that follow. Figure 2 shows a starting point for the PESIA. It is a map depicting the locations of the transmission lines as developed by NEA and the MCC due diligence consultants. These are referred to in the PESIA as the "initial lines" and were considered alternatives to the final routes developed during the Feasibility Study phase. The map also shows numerous

[46] Personal communication, Mr. Hitendra Dev Shakya, 16 January 2017

environmental and social resources that are further investigated in this PESIA. Figure 3 shows the final routes which are the subject of this PESIA.

**Procurement Packages**

As of this writing, the projects are expected to be procured as four packages, as follows:

Zone A EPC Contractor:

- NR1: Transmission line between New Damauli and Naubise
- NR1: New Damauli substation work
- NR1: Transmission line between New Damauli and New Butwal
- NR1: New Butwal 400 kV substation work (400 kV switchyard, transformers and 400 & 220 kV transformer bays) to connect to ADB's 220 kV substation
- XB1: Transmission line Between New Butwal substation and Nepal/India border
- T8: New Lamki 400 kV substation
- T8: 400 kV Transmission line between New Lamki substation and Nepal/India border

Zone B EPC Contractor:

- T3: 220 kV Transmission line between Tadhekani and Kusma
- T3: 220 kV Tadhekani substation work
- T3: 220 kV Kusma substation upgrade work
- NR4: Adding one circuit to the existing transmission line
- NR4: Upgrading (adding one line bay) to Balanch substation
- NR4: Upgrading (adding one line bay) to Attariya substation

Zone C EPC Contractor:

- NR1: Naubise 400 kV substation work
- NR1: 400 kV Lapsiphedi substation upgrade (400 kV switchyard, transformers and 400 & 220 kV transformer bays) to connect to ADB's 220 kV substation
- NR1: 400 kV New Hetauda substation upgrade (400 kV switchyard, transformers and 400 & 220 kV transformer bays) to connect to WB's 220 kV substation
- NR1: Transmission line between Naubise to Lapsiphedi
- NR1: Transmission line between Naubise to New Hetauda

Zone D EPC Contractor:

- T2': 220 kV Likhu Hub substation work
- T2': 220 kV New Khimti upgrade
- T2': Likhu Hub to New Khimti 220 kV transmission line
- NR3: Upgrading (adding two line bays) to Ilam substation
- NR3: Upgrading (adding two line bays) to Inaruwa substation

NR3: Ilam to Inaruwa 220 kV transmission line

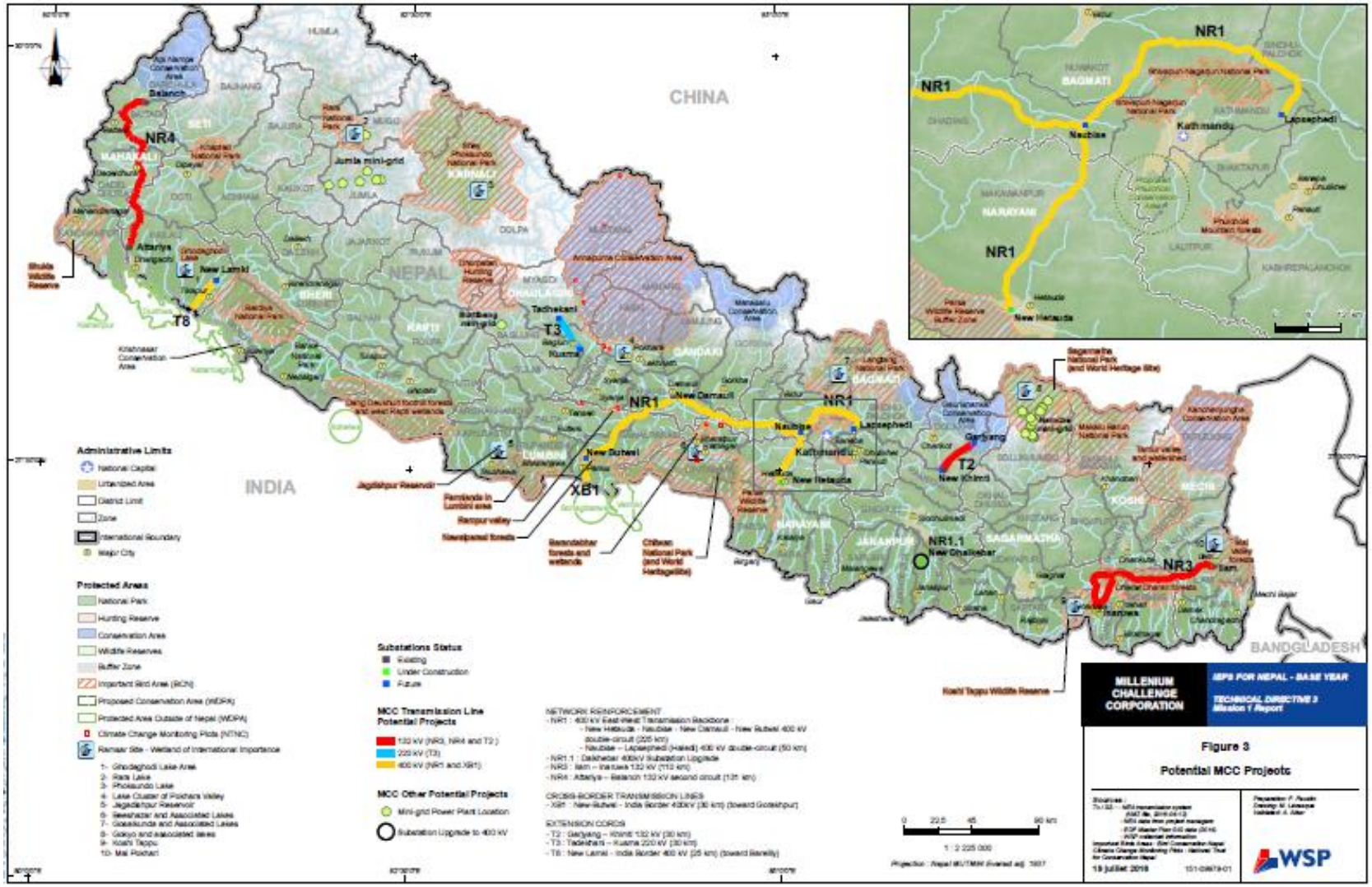


**Figure 2. Initial Transmission Lines and Substations Developed During the Due Diligence Stage**

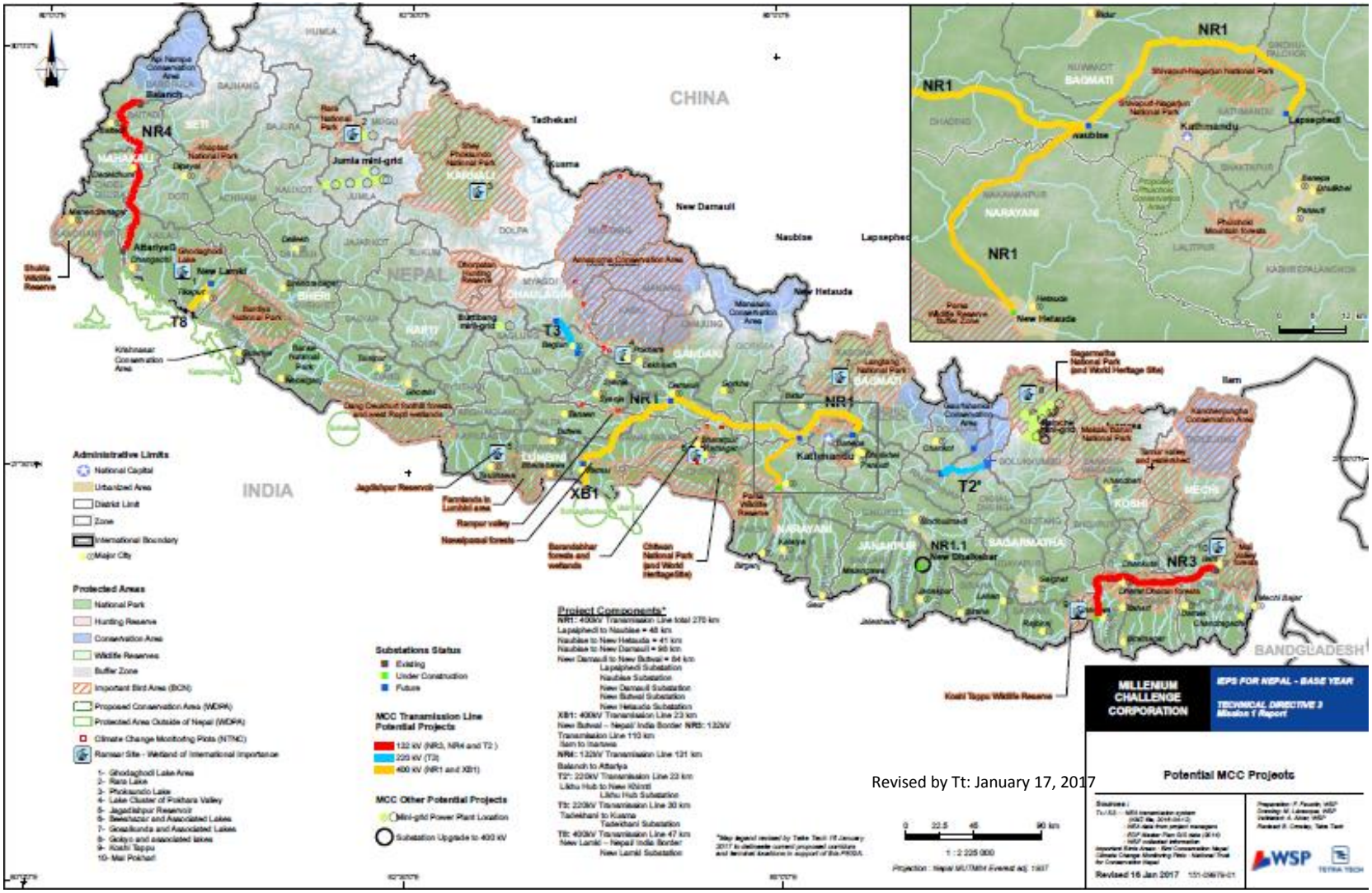


**Figure 3. Final Transmission Lines and Substations Developed During the Feasibility Study Stage**

### 2.1.1 Location of the Proposed Projects

The Government of Nepal identified a series of transmission line and substation projects that will help strengthen the country's power supply. The projects shown below are the proposed projects resulting from the Feasibility Study. The project alignments and locations of some of the substations were modified from those shown on Figure 2 as part of the study and the final project descriptions and their environmental context may be found in Figures 3 to 7. Detailed project specifications are contained in the "Feasibility Study: Nepal Priority Transmission Projects, Volume 1: Technical Feasibility Assessment."

**The East-West Transmission Backbone**
**NR1: 400 kV East-West Transmission Backbone**


**Figure 4. NR1 Transmission Backbone**

**Cross-Border Electricity Transmission**
**XB1: New Butwal 400 kV transmission line to the Nepal border**


**Figure 5. XB1 Cross-Border Line**

Note: The proposed NR1.1 project shown on Figure 2, which includes the Dhalkebar substation upgrade to 400 kV and the Dhalkebar – Hetauda transmission line upgrade to 400 kV, are being developed by a private firm from India. It is expected that the work will be completed by the time the MCC compact enters into the force. Hence, NR1.1 is not part of this feasibility study.

**Transmission Network Reinforcements**
**NR3: Upgrade of the Ilam-Inaruwa 132 kV transmission line**
**NR4: Upgrade of the Balanch-Attariya 132 kV transmission line**

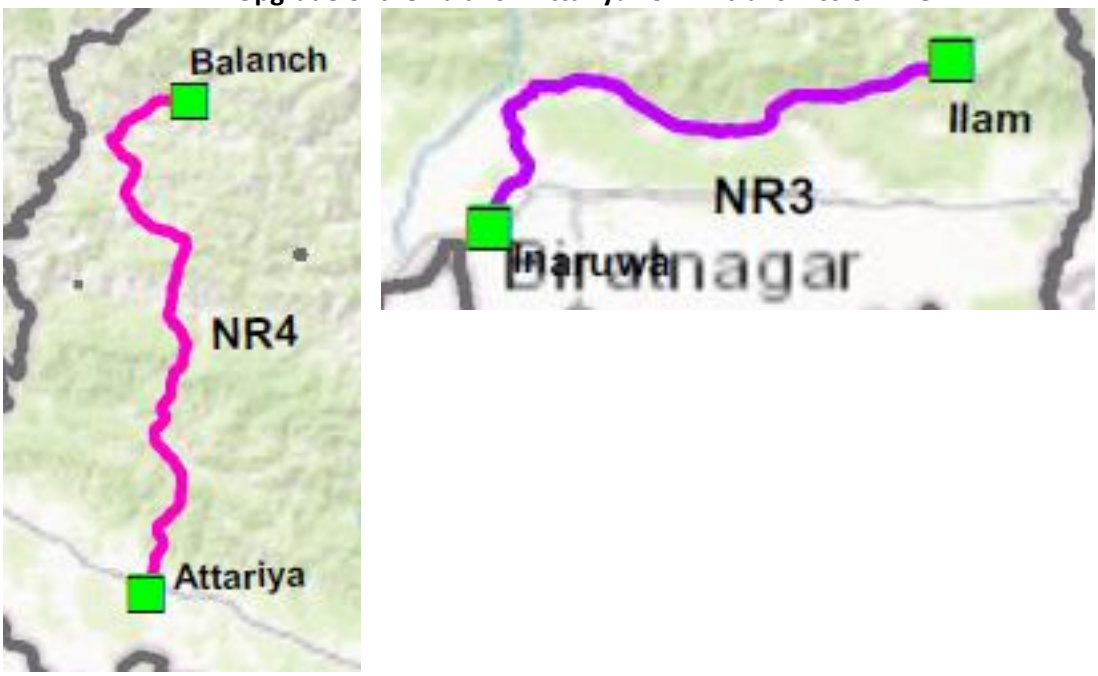


**Figure 6. NR3 and NR 4 Line Reinforcements**

**Enabling Generation – Connecting Generation Pooling Points to the National Grid or Nepal/India Border**
T2': Likhu Hub – New Khimti transmission line
T3: New Tadhekani-Kusma transmission line
T8: New Lamki substation and transmission line to the Nepal border


**Figure 7. T2', T3 and T8 Line Connections**

### 2.1.2 Sites, activities and processes

The transmission line and substation projects will typically be put in place in accordance with the following procedure.

**A. Clearing the right-of-way**
The right-of-way is cleared to build the transmission line and ensure the safety of the population, workers and the network. The type of clearing depends on the height of the trees, type of vegetation growing on the site and presence of sensitive areas. The particulars of clearing, including special provisions for cutting and/or trimming of trees will be in accord with special provisions described in other sections of this ESIA—*e.g.,* in section 4.1.14 on forests and community forests, and in a Resettlement Action Plan to be completed in accordance with the separate Resettlement Plan Framework for this Project discussed in Volume 3 of the Feasibility Study.

**B. Building temporary roads and trails**
First, the access requirements and traffic needs are determined. While existing routes are preferred, additional roads and trails may be required. In such cases, temporary accesses such as paths, bridges and culverts are constructed. These are built in the right-of-way, unless there are impassable obstacles blocking the route.

Alignment lengths and Rights of Way (ROW, which vary from 18 -46 meters depending on the subproject) are described in the project descriptions for the baseline/existing conditions (section 4) of this PESIA.

**C. Transporting materials to the tower sites**
The materials are transported to each tower site. This is done using trucks or other motorized vehicles whenever possible, but in some cases human porters and draft animals may be used in Nepal. Information gathered from various transmission line developers is that animals have largely been replaced by motorcycles.

**D. Building the foundations and anchors**
The construction team begins by clearing the project area. The workers are to carefully set aside the topsoil, which will be reused. During excavation for the foundations that will stabilize the tower, pumping may be required to remove groundwater and dry the site. The size of the excavation site depends on the type of soil and the type of tower. Anchors depend on the type of tower installed.

**E. Assembling and raising the towers**
First, the project area must be adapted to the type of tower that will be built. Because this step sometimes requires the use of heavy machinery, all the necessary precautions are taken. For example, in wetlands, steel plates are sometimes placed on the ground to accommodate the machinery and preserve the environment.

**F. Unreeling and installing the conductors**
The conductors are unreeled and strung section by section from tower to tower. There is a cable drum with a reel and tensioner at one end and a puller and take-up reel at the other. In this step, workers make sure that the tension levels in the conductors are within acceptable limits

and that there is adequate clearance between the ground and the cables. Practices are adapted to account for sensitive and special environments.

**G. Installing the counterpoise wires**

Counterpoise wires are installed to ground each tower and protect the line from lightning. A counterpoise wire is a special conductor that ensures the electrical connection between some or all of the line's towers and the ground.

When minor excavation and filling work is required, mitigation measures are implemented. For example, counterpoise wires are not installed near wetlands to avoid heavy machinery traffic and excavation.

**H. Restoring the site**

Once a project is complete, and depending on particular site conditions, the contractor restores the site typically by:

- removing all the debris and waste
- levelling the ground
- dismantling the temporary accesses (roads, bridges, culverts)
- repairing any infrastructure that was damaged during the work (roads, fences, etc.)
- seeding or planting whenever necessary based on the characteristics of the site (shoreline, wetland, etc.)
-

When the work is carried out on private land, Project management meets with the landowners to ensure they are satisfied with the restoration. It takes responsibility for any damages that may have occurred as part of the work and compensates the landowners according to project regulations.

### 2.1.3 Appurtenant Facilities

Other facilities, including requirements for construction camps, storage/servicing depots, estimated number of workers during construction, etc. will be specified during the preliminary and final design stages of the Project. Many of these specifications depend on the particular contractor's proposed techniques and cannot be foreseen at this time.

### 2.1.4 Implementation schedule

An implementation schedule is shown on the following page (Figure 8). The schedule is subject to change during the period that the final ESIA is prepared. Furthermore, the work of the ESIA is subject to the progress on the Preliminary Design and the RAP, as indicated schematically in the schedule.

| | ESIA Schedule | | | Year 1 | | | | | | | | | | | | Year 2 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Activity ID | Activity Name | Duration (m) | Precedent | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D |
| 1.00 | Preparation of Preliminary Designs | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.50 | Preparation of Final Designs | | 3.05 | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.00 | Milestone: Completion of the RAP | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.00 | **Preparation of ESIA (for each package)** | 18 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.01 | Scoping | 2 | 1.00 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.02 | Regulatory Requirements | 1 | 3.00 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.03 | Description of Proposed Activities | 2 | 3.00 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.04 | Description of Baseline Conditions | 9 | 3.03 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.05 | Determination of Potential Impacts | 7 | 2.00 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.06 | Analysis of Alternatives | 3 | 3.04 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.07 | Environmental and Social Management Plans | 4 | 3.06 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.08 | Benefit Sharing Mechanisms | 4 | 3.06 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.09 | Indigenous Peoples Assess (PS 7+ IPP if needed) | 9 | 3.03 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.10 | Biodiversity Assess. (PS 6 + BAP if needed) | 6 | 3.03 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.11 | Report Preparation (Draft & Final ESIA) | 4 | 3.07 | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.00 | Approvals / permits | 4 | 3.10 | | | | | | | | | | | | | | | | | | | | | | | | |
| 5.00 | Stakeholder Engagement and Public Disclosure | ongoing | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |

**Figure 8. Schedule for Preparation of the ESIA**

## 2.2 Methodology for Multi-Criteria Route Selection of Transmission Lines and Substations

All routes except NR4 and T8, were initially generated by the stakeholder-driven multi-layer LRT model described in this section. Only NR1 was subject to multiple iterations of the model although the adjusted weighting values from the final iteration of NR1 were applied to the other routes. Although the manual "fine-tuning" approach applied to the LRT results generally stayed within the LRT-identified corridors there were some areas were the final route selected went outside the corridors in order to adjust for constraints, such as high elevation, that were not incorporated in the LRT due to lack of data.

A multidisciplinary routing team, including engineers, social and environment impact specialists, and resettlement experts, fine-tuned each route, using detailed examination of aerial photography and limited ground truthing. See also section 6.1.1 Impact Assessment Methodology and Annex J for more details.

The LRT incorporated a range of technical/physical data inputs and weighting values that translate directly to the cost of construction of the transmission line. In a minimally constrained model the cost-distance analysis will create the shortest path from origin to terminus. Deviations from the straight-line path are a result of a longer path being less costly, due to constraints that are greater than the cumulative penalty imposed by crossing additional cells.

Engineering values represented by weights placed on soils, geology, terrain, roads and footpaths, waterbodies and to some extent land cover, all reflect suitability for construction of transmission lines and thus cost. Weights assigned to geologic formations were assigned based on expert knowledge of

formation stability and factors such as hardness of material that would require drilling for footings of towers. Proximity to roads was considered as a factor in ease of access to a transmission line route, thus reducing time and cost of construction. This particular input does deserve further discussion as it raises the issue of land acquisition costs. A transmission line route that is easily accessed by existing roads would be less expensive and quicker to construct than one in a remote and roadless area. However, the cost of land that is well served by existing roads is much higher than that in remote areas. Land cost was not considered in the LRT model based on assumptions of practices promoting environmental justice. In other words, low land values are usually related to poor or low income areas and routing the lines through those areas to reduce land acquisition costs would unfairly burden poorer areas.

### 2.2.1 Traditional Routing Approach

The traditional approach to stakeholder involvement in project siting consists of presenting a set of proposed and alternative sites (or routes) to the affected parties, after the siting process has been essentially completed. In Nepal, the approach to siting specific transmission lines begins with desk studies, and an application for a Survey License, which often triggers an environmental assessment, with stakeholder input coming later. The approach outlined here allows for stakeholder representation at all phases of the siting process. This methodology is intended to create least constraint/cost solutions, generated by transparent and reproducible methods that consider all available data and incorporate siting criteria developed by technical experts in collaboration with stakeholders and their representatives.

### 2.2.2 Multi-Criteria Routing Approach

A participatory multi-criteria route selection process was used to delineate the transmission lines. For each of the potential lines, this approach involved the following four steps:

(**Step 1**) Gather and verify data in the form of geo-referenced GIS layers, and look at the general corridors suggested by the preliminary routes laid out by WSP (and NEA, the electric authority) as a starting point for the routing process.

(**Step 2**) Implement the Linear Routing Tool (LRT)[47] using the GIS information. The process also involves providing weights to each of the attribute layers being used in the model. These weights were originally assigned by the multi-disciplinary team, and then modified using stakeholder preferences gathered in the October 2016 workshop and with a questionnaire survey (see table in Annex J). The weights basically told the model what features should receive higher importance than others when routing.[48] It should be noted that the October 2016 workshop participants were from

[47] LRT is Tetra Tech proprietary software that uses ESRI GIS as its base.

[48] Note: the LRT model takes a lot of effort to set up and many hours of computer time to run. At one point the team could no longer wait for all the lines to be routed using the model, and a decision was made to use the model

Government agencies and NEA, and were based in Kathmandu. Later field work contacted stakeholders in areas potentially impacted and the weights were adjusted as needed.

(**Step 3**) The results of the LRT were then reviewed using multi-criteria analysis by overlaying the LRT-preferred routes on Google Earth and fine tuning the routes using current data, the local knowledge of the team's national experts, and keeping in mind the wishes of stakeholders.

(**Step 4**) These routes were then turned over to the engineers who used a program called PLS-CADD to do a preliminary design of the routes, again making minor route changes where needed by the design constraints.

### 2.2.3 The LRT (Linear Routing Tool) Model

Annex J presents an outline description of the route selection process and tools used to meet these requirements. The transmission line corridors – presented as the preferred alternatives – were developed using the multi-criteria assessment process discussed in this section. The flow of this approach is illustrated in Figure 9.

on the NR-1 route (the longest and most complex line), and skip step (2) above for NR-3. This was successful and routing for all the lines was subsequently completed (most with LRT and some without).

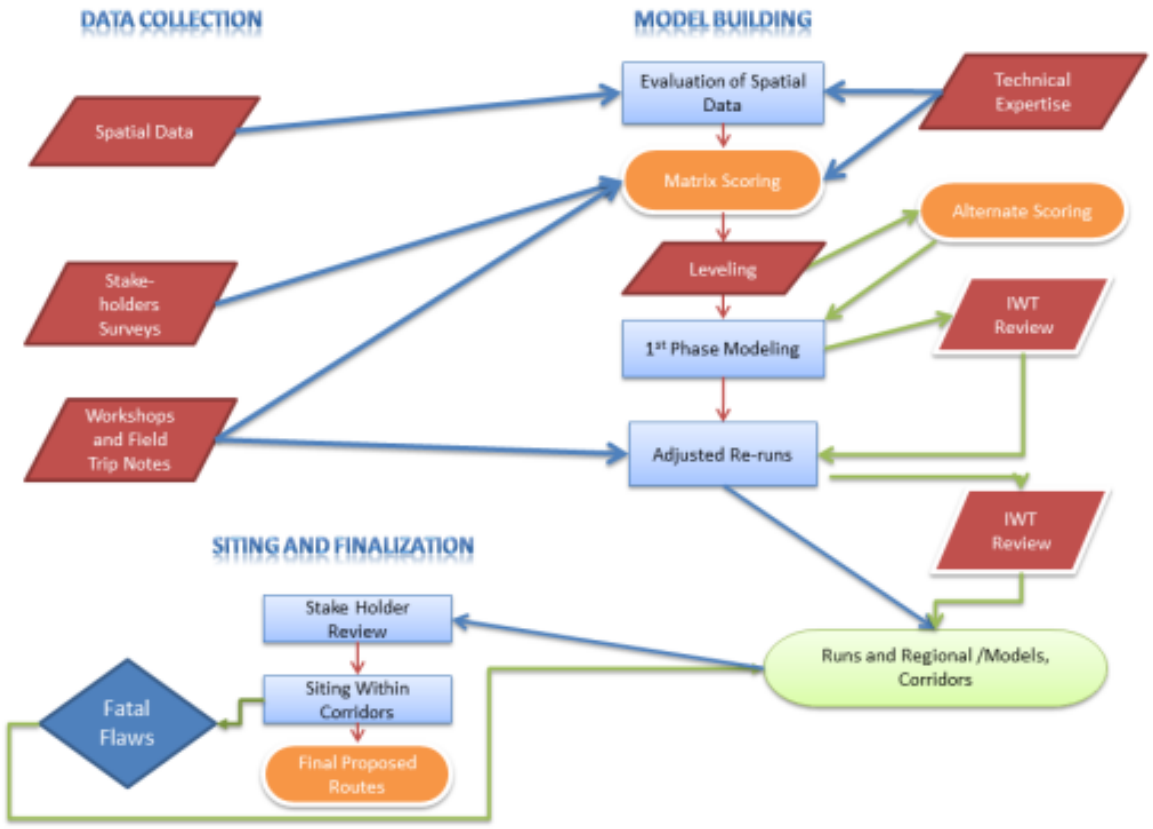


**Figure 9. Multi-Criteria Route Selection of Transmission Lines and Substation**

# 3. Stakeholder Engagement and Consultations

## 3.1 Purpose and Context of Stakeholder Engagement

### 3.1.1 Purpose

Stakeholder engagement and consultation are vital parts of this feasibility study and PESIA. As discussed above, stakeholder input has been integrated into the selection of the corridors, and it is expected that stakeholders will continue to be engaged during the duration of the compact project design, ESIA, construction and operation.

The Stakeholder Engagement Framework (SEF)[49] is designed to:

- Define the policies and guiding principles for stakeholder engagement applicable to compact development
- Identify compact-wide stakeholder engagement and communication objectives and information needs during the compact development phase
- Identify compact stakeholders using a stakeholder mapping approach
- Define the activities, tools and procedures needed to complete the stakeholder engagement process during compact development, including redress of grievances and reporting
- Define roles and responsibilities to manage stakeholder engagement during compact development
- Establish parameters for ongoing stakeholder engagement during subsequent stages of the compact, including the development of stakeholder engagement plans for each compact project and the hand-off of stakeholder engagement data and plans from one stage to the next.

This SEF is designed as a dynamic planning tool for implementation purposes and will be updated periodically as needed throughout the compact-development phase.

The PESIA team, guided by a series of discussions led by MCC/OMCN staff, and considering some of the lessons experienced under earlier development projects, approached stakeholder engagement in a structured way, eliciting views and opinions without making commitments and/or raising expectations. At the feasibility stage and considering time constraints, it was determined that the emphasis should be focused at engaging district-level actors, taking opportunities to engage potential village and community stakeholders whenever possible. Much of the discussions were aimed at drawing lessons from experience, and understanding needs, expectations and priorities associated with development opportunities, and specific groups, such as community forest users. The line routing approach applied a weighting to reflect these social and gender preferences.

[49] The SEF is a dynamic document that will be in force during the entire compact period. Please see Annex C for the current SEF as of November 30, 2016.

### 3.1.2 Feasibility Study Context

The Environmental and Social Management System (ESMS) that is being developed by MCC's Due Diligence consultants contains an SEF (see Annex C) that specifies the process that will be followed to maintain full engagement of all stakeholders in this project. The SEF is the responsibility of MCC and OMCN to complete, and the PESIA consultants will abide by the current SEF and hand over stakeholder engagement information to OMCN at the end of the PESIA preparation period.

Maintenance of the Stakeholder Register and Database is the responsibility of the OMCN. During the Feasibility stage, the principal inputs from Stakeholders was as follows:

- Stakeholders have provided information for the analysis to all the tasks: engineering, environmental and social, resettlement, economics and finance, implementation, sustainability, and monitoring.
- Stakeholders participated in the Transmission line routing by expressing their preferences with regard to the criteria used to define the preferred lines. Please refer to Section 2.2 and Annexes B and J of this report for the methodologies used to engage stakeholders and the results.
- Stakeholders will be kept informed throughout the Project lifecycle, and opportunities made available to them for expressing preferences and constraints as the project is designed and implemented.
- Stakeholders will have access to a Grievance Mechanism that will address their concerns during the design, construction, and operation of the projects.

### 3.1.3 Site Visits and Field Discussions

During the early part of the pre-feasibility project development, teams visited the Far Western, Middle and Eastern regions of Nepal in which substations and transmission lines were likely to be constructed, expanded or rehabilitated. The teams focused largely on district-level discussions, although a few community-level interactions were held. The visits were assisted in obtaining feedback on the issues associated with earlier transmission line projects, and in gaining a better perspective of potential risks that further investments might face in implementation, especially within MCC's five-year compact period.

From a social and gender perspective, the site visits that were conducted as part of prefeasibility, although brief and not accompanied by structured surveys and focus group discussions, did highlight the needs and challenges faced by the diverse groups that make up the country's citizens. From Dalits in the Far West to indigenous peoples in the Mid and Eastern regions, poverty reduction, both income and non-income, is a priority. Although civil society organizations, largely funded by donors, are heavily involved in outreach, empowerment and income-generation programs, among others, it is evident that infrastructure development must play a key part in creating the economic growth that will further drive poverty levels down. In discussions with local governments and community-based organizations, such as

forest users, there is evidence of considerable ongoing development activities. The challenges to ensuring the sustainability of those efforts include focus on both local and regional interventions, including increasing agricultural productivity, creating markets and distribution systems, preparing for and responding to natural disasters, empowering women, dealing with the impacts of workforce migration, and the like. Those challenges need to be complemented by benefits associated with infrastructure development, such as the transmission line upgrading and rehabilitation activities under a proposed project.

Among gender priorities, there is a significant need to provide new and innovative income-generating opportunities that should be explored as part of the proposed compact development. Women play a critical part in tackling the intergenerational transmission of poverty through, for example, enabling education for children, providing proper health, nutrition and sanitation, establishing value systems that stem violence against women, and having a voice in decision-making, whether at household, community or government levels.

# 4. Baseline Information

The proposed projects are situated throughout Nepal. Sections 4.1 and 4.2 present a summary of the existing baseline environmental and social conditions in Nepal that apply in general to all the proposed projects, followed by more detailed project-specific information. The project-specific sections starting at Section 4.3 cover the following topics (as appropriate) for each project:

- **Physical** (covering geophysical issues such as seismic danger, flooding risk, slope, erosion, landslide potential, and soils; water quality and water resources; air quality and noise; hazardous materials/waste; and, greenhouse gas emissions)
- **Ecological** (including protected areas, rare and endangered species habitats and wildlife corridors, important bird areas, and ecosystem services)
- **Socio-economic** (discussing general impacts on the national economy, local/regional, gender issues, such as the potential for gendered differences in impacts, potentially affected households, agriculture, communities, indigenous and vulnerable people issues such as changes in population expected changes in governance, institutions or practices, formal or territorial disputes, and changes in land use or other economic uses of affected lands; land use, including urban, agricultural/pastoral, and various types of forests.
- **Cultural** (including temples, sacred forests, visual resources, and touristic resources)

## 4.1 General Environmental Context

### PHYSICAL RESOURCES

#### 4.1.1 Climate

Nepal has a great deal of variation in climate, with tropical and subtropical climates in the Tarai Region and completely different climatic conditions outside the Tarai. The remarkable differences in climatic conditions are primarily related to the enormous range of altitude within such a short north-south distance. The presence of the east-west-trending Himalayan massifs to the north and the monsoonal alteration of wet and dry seasons also greatly contribute to local variations in climate.

In general, climatic zones in Nepal are categorized by temperature regimes based on altitudinal ranges. These climatic zones are sub-tropical (<1,000 m elevation), warm-temperate (1,000–2,000 m elevation), cool-temperate (2,000–3,000 m elevation), alpine (3,000–4,000 m elevation) and arctic (>4,500 m elevation).

In terms of natural vegetation regimes or distribution patterns, altitude again plays a significant role. Below 1,200 m, the dominant form of vegetation consists of tropical and subtropical rain forests.

The Tarai region is in sub-tropical climatic zone characterized by hot and humid summers, intense monsoon rain, and dry winters. The annual rainfall decreases gradually from the Eastern to the Western Tarai. The annual total rainfall in this region varies from 1,138 mm to 2,680 mm, and the mean monthly precipitation ranges from 8 mm to 535 mm.[50]

The climate of Churia region ranges from sub-tropical to warm-temperate and is characterized by hot and sub-humid summers, intense monsoon rain, and cold dry winters. The precipitation pattern in Churia is variable, with the highest annual rainfall in the Eastern and Central Development Regions. The total annual rainfall varies from a minimum of 1,138 mm to the maximum of 2,671 mm.[51]

In Middle Mountains, the climate ranges from sub-tropical, sub-humid in river valleys to warm temperate in valleys to cool-temperate in the high hills. Annual precipitation varies from east to west with the highest in the Western Development Region (1,898 mm).

The climate in the High Mountains and High Himal regions ranges from warm-temperate in the valleys to cool-temperate in the higher elevations and arctic in the uppermost elevations. Precipitation in the region varies from east to west, with the highest in the Central Development Region with a total annual precipitation of 2,185 mm. Trans-Himalayan areas receive very little precipitation, and are also known as cold desert.

**Precipitation**

The remarkable differences in climatic conditions in Nepal are primarily related to the enormous range of altitude within such a short north-south distance. Altitude has a significant effect on the annual rainfall or precipitation patterns. Up to about 3,000 meters, annual rainfall totals increase as the altitude increases; thereafter, annual totals diminish with increasing altitude and latitude. In addition to this latitudinal differentiation in rainfall, two other patterns can be discerned. First, given the north-westward movement of the moisture-laden summer monsoon (June to September), the amount of annual rainfall generally decreases from east to west. However, there are certain pockets with heavy annual rainfall totals, for example, the Pokhara Valley in central Nepal. Second, the horizontal extension of hill and mountain ranges creates a moist condition on south and east facing slopes, whereas it produces a major rain shadow on the northern sides of the slopes. The aridity increases with altitude and latitude, especially on the northern slopes, and reaches its climax in the inner Himalayan region and on the Tibetan Plateau. Eastern Nepal receives approximately 2,500 mm of rain annually, the Kathmandu area about 1,420 mm, and western Nepal about 1,000 mm.

The Himalayas play a critical role in rainfall, blocking the north-westerly advances of moist, tropical air from the Bay of Bengal, and ultimately leading to its conversion to rain in the summer. In the winter, this range prevents the outbursts of cold air from Inner Asia from reaching southern Nepal and northern India, thus ensuring warmer winters in these regions than otherwise would be the case.

[50] Central Bureau of Statistics. 2014. Environmental Statics of Nepal. 2013
[51] Ibid.

In addition, there are seasonal variations in the amount of rainfall, depending on the monsoon cycle: pre-monsoon, summer monsoon, post monsoon, and winter monsoon. The pre-monsoon season generally occurs during April and May; it is characterized by the highest temperatures, reaching 40° C during the day in the Tarai Region and other lowlands. The hills and mountains, however, remain cool.[52]

The summer monsoon, a strong flow of moist air from the southwest, follows the pre-monsoon season. Even though the arrival of the summer monsoon can vary by as much as a month, in Nepal it generally arrives in early June, is preceded by violent lightning and thunderstorms, and lasts through September, when it begins to recede. The plains and lower Himalayas receive more than 70% of their annual precipitation during the summer monsoon. The amount of summer monsoon rain generally declines from southeast to northwest as the maritime wedge of air gradually becomes thinner and dryer. Although the success of farming is almost totally dependent on the timely arrival of the summer monsoon, it periodically causes such problems as landslides; subsequent losses of human lives, farmlands, and other properties; and heavy flooding in the plains. Conversely, when prolonged breaks in the summer monsoon occur, severe drought and famine often result.[53]

The post-monsoon season begins with a slow withdrawal of the monsoon. This retreat leads to an almost complete disappearance of moist air by mid-October, thus ushering in generally cool, clear, and dry weather. The post -monsoon season lasts until about December.

The post monsoon is followed by the winter monsoon, a strong north-easterly flow, which is marked by occasional short rainfalls in the lowlands and plains and snowfalls in the high-altitude areas. The amount of precipitation resulting from the northeast land trade winds varies considerably but increases markedly with elevation. The secondary winter precipitation in the form of snowfalls in the Himalayas is important for generating a sufficient volume of spring and summer meltwaters, which are critical for irrigation in the lower hills and valleys where agriculture predominates. Winter precipitation is also indispensable for the success of winter crops, such as wheat, barley, and numerous vegetables.

Rainfall data for Nepal for the years 2001-2012 are presented in Table 8.

**Sunshine Hours**

Due to its location (between latitudes 26° 22’ and 30° 27’ N and longitudes 80° 40’ and 88° 12’ E), solar radiation is abundant; sun shines a little over 300 days a year. On average Nepal has 6.8 sunshine hours per day, or 2,482 sunshine hours per year with the intensity of solar insolation ranging from 3.9 to 5.1 kWh/m2/day.[54] However, from mid-June to early October, during the monsoon season, it rains almost every day and most of the Himalayas are hidden behind the clouds.

[52] The Climate of Nepal. http://www.geography-site.co.uk/pages/countries/climate/nepal_climate.html. Accessed 15 Nov 2016
[53] Ibid.
[54] Shrestha, J N. 2014. Application of Clean Energy in Nepal: Prospects and Problems. SAR/StANCE Meeting

Average sunshine hours in Nepal are presented in Table 9 below.

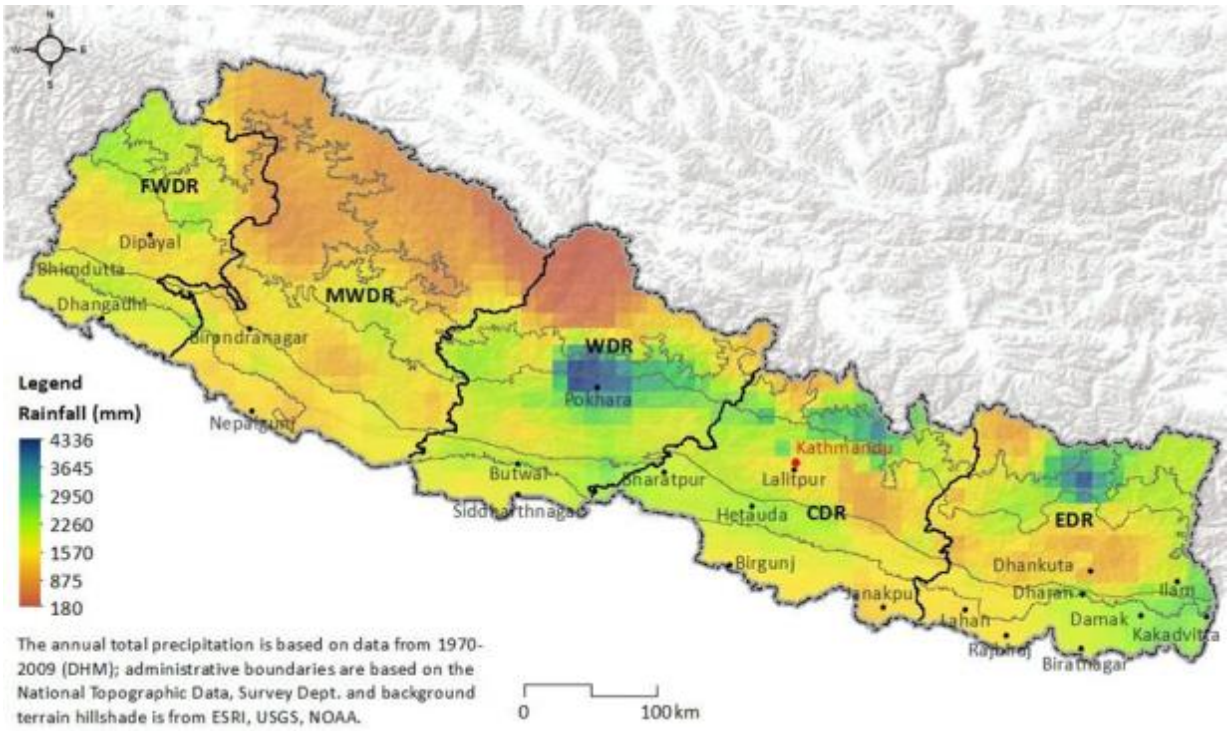


**Figure 10. Rainfall Map of Nepal**
Source: http://www.geography-site.co.uk/pages/countries/climate/nepal_climate.html. Accessed 15 Nov 2016

**Wind Patterns**

Although significant wind potential is noted to be available in the mountainous region (Mustang district, Khumbu region, Palpa, Ramechhap, Karnali Chisapani, Jumla) no proper wind mapping of Nepal has been done.[55]

In Nepal, the wind velocities in low altitude valleys are lower in magnitude than those in the high-altitude valleys and mountain ridges. This is evident from data observed in Kathmandu (low values) and Kaligandaki valleys (high values). Nepal's national building code NBC 104:1994 on wind load has divided the whole country into two regions: the first region, lower plains and hills, generally include the southern plains (Tarai), Kathmandu Valley and areas generally below 3000 m altitude, where the basic wind velocity is 47 m/s. The second region lies above 3000 m and the basic wind velocity in region is 55 m/s[56].

Table 10 shows the wind patterns and speeds in Nepal.

[55] Ibid.
[56] Upreti BN, Shakya A. 2009. Wind energy potential assessment in Nepal

**Temperature**
In Nepal, over the course of a year, the temperature typically varies from 3°C to 30°C and is rarely below 2°or above 32°C.

The *warm season* lasts from April 10 to October 11 with an average daily high temperature above 27°C. The hottest day of the year is June 8, with an average high of 30°C and low of 20°C.

The *cold season* lasts from December 6 to February 12 with an average daily high temperature below 21°C. The coldest day of the year is January 6, with an average low of 3°C and high of 18°C.

Table 11 presents the temperature variations in Nepal.

### 4.1.2 Physiography

With an area of 147,181 km$^2$, Nepal occupies the central part of the Himalayas located between the Palearctic (Holarctic) and Paleotropical (Indo-Malayan) regions. Altitude varies from 67 masl (meters above sea level) at Kechana Kalan, Jhapa, in the south-eastern Tarai, to 8,848 masl at Mt. Sagarmatha (Everest), the highest point in the world. There are five physiographic regions in Nepal based on geology and geomorphology.

The Tarai physiographic region of Nepal occupies 13.7% of the total land area of the country. In terms of geomorphology, it consists of gently sloping recent and post-Pleistocene alluvial deposits, which form a piedmont plain south of the Himalayas. Its elevation varies from 63 m to 330 masl.[57]

The Churia region (also called Siwalik) is the youngest mountain range in the Himalayas. Just north of the Tarai, it runs the entire length of southern Nepal, from east to west, skirting the southern flanks of the Himalayas. The region occupies about 12.8 % of the total land area of the country, and covers parts of 36 districts of Nepal. The elevation of Churia varies from 93 to 1,955 masl.

The Middle Mountains region lies north of Churia along the southern flanks of the Himalayas. The region occupies 29.2% of the total land area of the country and covers parts of 55 districts. The elevation of Middle Mountains region varies from 110 m in the lower river valleys to 3,300 masl.

The High Mountains region occupies 20.4% of the total land area of the country and covers parts of 40 districts. The elevation of this region varies from 543 masl in the river valley floors to 4,951 masl. The region is characterized by the rugged landscape and very steep slopes.

[57] DFRS, 2015. State of Nepal's Forests. Forest Resource Assessment (FRA) Nepal, Department of Forest Research and Survey (DFRS). Kathmandu, Nepal

The High Himal region which includes the highest Himalayan massifs, occupies about 23.9% of the total land area of the country, and covers parts of 25 districts. The region's elevation ranges from 1,960 masl to 8,848 masl.[58] Figure 11 presents the physiographic regions in Nepal.

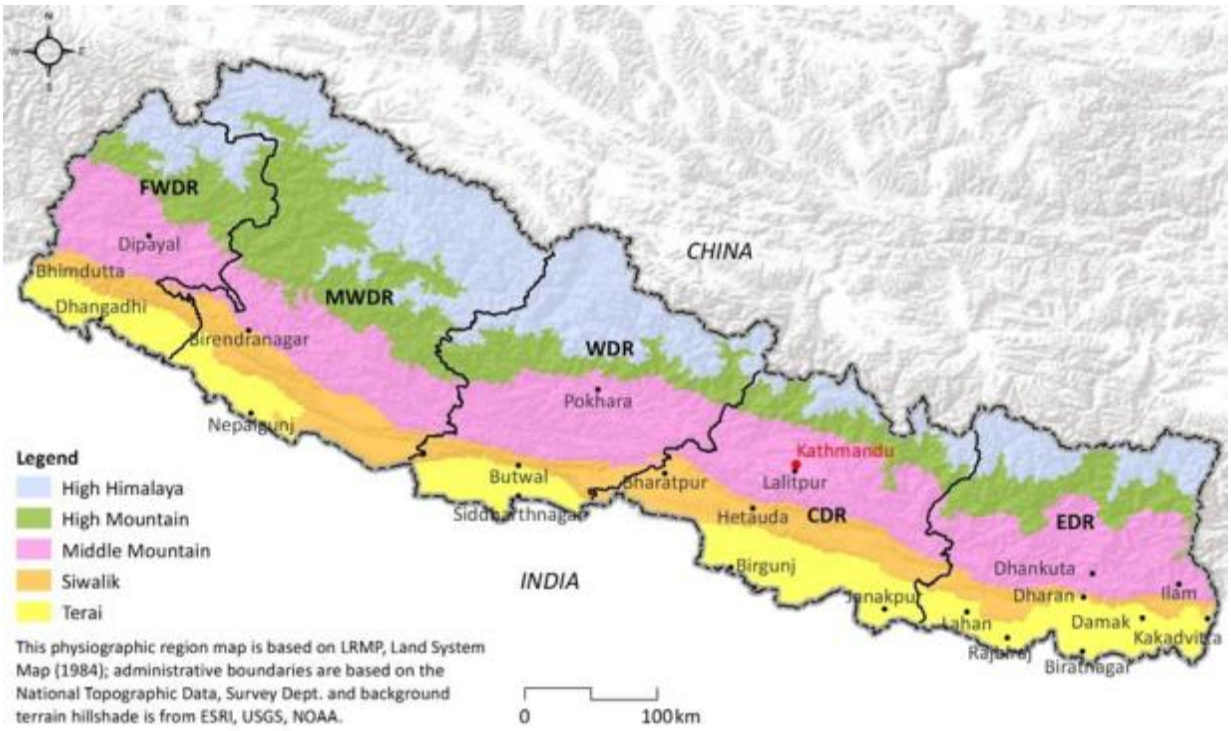


**Figure 11. Physiographic Regions of Nepal**
Source: DFRS, 2015.

[58] Ibid.

Table 8. Annual Rainfall by Station (mm)

| S. N. | Station | Latitude | | Longitude | | Elevation (masl) | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Banke, Nepalganj | $28^0$ | 06' | $81^0$ | 40' | 165 | 1279 | 967 | NA | 929 | 1184 | 1242 | 2567 | 1781 | 1585 | 1503 | 1396 | 1080 |
| 2 | Bara, Simara Airport | $27^0$ | 10' | $84^0$ | 59' | 130 | 2297 | 1949 | 2150 | 1965 | 1864 | 1861 | 2897 | 1643 | 1312 | 1580 | 1832 | 893 |
| 3 | Bhaktapur, Nagarkot | $27^0$ | 42' | $84^0$ | 59' | 2163 | 185 | 2321 | 2260 | 1807 | 1797 | 1669 | 2000 | 1512 | 1503 | 1715 | 2178 | 1768 |
| 4 | Bhojpur, Bhojpurr* | $27^0$ | 11' | $85^0$ | 13' | 1595 | 1304 | 1178 | 1086 | - | - | - | - | - | - | - | | |
| 5 | Chitawan, Rampur | $27^0$ | 37' | $84^0$ | 25' | 256 | 234 | 2644 | 2694 | 2042 | 1732 | 1997 | 2743 | 1786 | 1909 | 2400 | 1184 | 1636 |
| 6 | Dadeldhura | $29^0$ | 18' | $80^0$ | 35' | 1848 | 132 | 1293 | 1391 | 1194 | 1102 | 941 | 1669 | 1479 | 1746 | 1527 | 1251 | NA |
| 7 | Dailekh, Dailekh | $28^0$ | 51' | $81^0$ | 43' | 1402 | NA | 1327 | 1999 | 1281 | 1792 | 1784 | 1697 | 1986 | 1686 | 1163 | 1785 | NA |
| 8 | Dang, Ghorahi | $28^0$ | 03' | $82^0$ | 30' | 634 | 1633 | 1364 | 1700 | 1318 | 1557 | 1266 | 1878 | 1363 | 1551 | 1569 | NA | NA |
| 9 | Darchula, Darchula | $29^0$ | 51' | $80^0$ | 34' | 1097 | 227 | 2183 | 2864 | 2616 | 2281 | 2386 | 3256 | 2336 | 2533 | 2963 | NA | 2254 |
| 10 | Dhankuta, Dhankuta | $26^0$ | 59' | $87^0$ | 21' | 1210 | 959 | 1090 | 1086 | 951 | 1156 | 859 | 964 | NA | 933 | 870 | 834 | 707 |
| 11 | Dolakha, Jiri | $27^0$ | 38' | $86^0$ | 14' | 2003 | NA | NA | 2839 | 2613 | 2015 | 1980 | NA | 2863 | 2010 | 2556 | 2682 | 2325 |
| 12 | Dolpa, Dunai | $28^0$ | 56' | $82^0$ | 55' | 2058 | 174 | NA | 273 | 203 | 94 | 266 | 175 | 292 | 200 | 458 | 441 | NA |
| 13 | Doti, Dipayal | $29^0$ | 15' | $80^0$ | 57' | 617 | 998 | 1025 | 1261 | 1034 | 987 | 907 | 1035 | 1096 | 1359 | 954 | 176 | 982 |
| 14 | Gorkha, Gorkha | $28^0$ | 00' | $84^0$ | 37' | 1097 | 1872 | 1743 | 1729 | 1613 | 1277 | 1114 | 1763 | NA | 1476 | 1900 | 1999 | 1896 |
| 15 | Gulmi, Tamghas | $28^0$ | 04' | $83^0$ | 15' | 1530 | 1974 | 1399 | 2314 | 1234 | 1570 | 1457 | 2239 | 1773 | 1794 | 1490 | 1807 | 1923 |
| 16 | Ilam, ilam Tea State | $26^0$ | 55' | $87^0$ | 54' | 1300 | 1331 | 1542 | 2001 | NA | NA | 1119 | NA | NA | 1243 | NA | NA | NA |
| 17 | Dhanusha, Janakpur Airport | $26^0$ | 43' | $85^0$ | 58' | 90 | 1775 | 1591 | 2008 | 2199 | 1307 | 1292 | 2563 | 1211 | 1320 | 964 | NA | 1042 |
| 18 | Jhapa, Kankai | $26^0$ | 35' | $87^0$ | 54' | 143 | 244 | 2311 | 2748 | 2451 | 1832 | 1697 | 2495 | 2860 | 2568 | 3027 | 2622 | 1839 |
| 19 | Mustang, Jomsom | $28^0$ | 47' | $83^0$ | 43' | 2744 | 240 | 308 | 319 | 230 | 309 | 302 | 312 | NA | 322 | 286 | 222 | 215 |
| 20 | Jumla, Jumla | $29^0$ | 17' | $82^0$ | 14' | 2300 | 728 | 842 | 843 | 685 | 670 | 748 | 832 | 967 | 696 | 795 | 945 | 785 |

Table 8. Annual Rainfall by Station (mm)

| S. N. | Station | Latitude | | Longitude | | Elevation (masl) | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | Kailali, Dhangadi | $28^0$ | 41' | $80^0$ | 41' | 170 | 1485 | 1626 | 2309 | 1418 | 1742 | 1448 | 2602 | 2677 | 2286 | 2070 | 1822 | 883 |
| 22 | Kanchanpur, Mahendranagar | $29^0$ | 03' | $80^0$ | 22' | 176 | 1407 | 2006 | NA | NA | 1680 | 1056 | NA | NA | 2843 | 1949 | 1593 | 1666 |
| 23 | Kaski, Lumle | $28^0$ | 18' | $84^0$ | 00' | 1740 | 5936 | 5730 | 6310 | 6096 | 4923 | 4162 | 6056 | 5902 | 4873 | 5700 | 5653 | 4689 |
| 24 | Kaski, Pokhara Airport | $28^0$ | 13' | $83^0$ | 48' | 827 | 4512 | 4484 | 4362 | 4129 | 2967 | 3024 | 4272 | 3263 | 3256 | 3967 | 3487 | 3266 |
| 25 | Kathmandu, Airport | $27^0$ | 42' | $85^0$ | 22' | 1336 | 1621 | 1871 | 1740 | 1583 | 1236 | 1391 | 1346 | 1220 | 1205 | 1479 | 1655 | 1465 |
| 26 | Lamjung, Khudibazar | $28^0$ | 17' | $84^0$ | 22' | 823 | 314 | 3304 | 3849 | 3849 | 2838 | 2852 | 3372 | 3690 | 2642 | 3281 | 3338 | 3099 |
| 27 | Makawanpur, Hetauda | $27^0$ | 25' | $85^0$ | 03' | 474 | 2680 | 3323 | 2998 | 3103 | 2411 | 2114 | 2588 | 2134 | 2125 | 2676 | 2587 | 1626 |
| 28 | Manang, Chame | $28^0$ | 33' | $84^0$ | 14' | 2680 | 530 | 909 | NA | 974 | 1174 | 947 | 1683 | 1017 | 482 | 1235 | NA | NA |
| 29 | Morang, Biratnagar Airport | $26^0$ | 29' | $87^0$ | 16' | 72 | 2279 | 1923 | 2108 | 2144 | 1596 | 1300 | 2117 | 1700 | 1690 | 1870 | 1920 | 1058 |
| 30 | Nawalparasi, Dumkauli | $27^0$ | 41' | $84^0$ | 13' | 154 | 297 | 2591 | 3280 | 2611 | 2213 | 2117 | 3264 | 1966 | 1924 | 2668 | 2203 | 2148 |
| 31 | Nuwakot, Nuwakot | $27^0$ | 55' | $85^0$ | 10' | 1003 | 2484 | 2111 | 2216 | 2007 | 1589 | 1255 | 1550 | NA | 882 | NA | NA | NA |
| 32 | Okhaldhunga, Okhaldhunga | $27^0$ | 19' | $86^0$ | 30' | 1720 | 2192 | 2001 | 1716 | 1619 | 1902 | 1696 | 2180 | NA | 1594 | 1574 | 1896 | 1721 |
| 33 | Palpa, Tansen | $27^0$ | 52' | $83^0$ | 33' | 1343 | - | - | 1799 | 1509 | 1294 | 1130 | 1571 | 1536 | 1344 | 1734 | 1129 | 1942 |
| 34 | Bara, Nijghad | $27^0$ | 11' | $85^0$ | 10' | 244 | 2130 | 2524 | 2326 | 2929 | NA | NA | NA | NA | 1108 | 1146 | 1540 | NA |
| 35 | Rupandehi, Bhairahawa | $27^0$ | 31' | $83^0$ | 26' | 109 | 2016 | 1269 | 1953 | 1524 | 1768 | 1214 | 2066 | 1669 | 1504 | 1904 | 1284 | 1387 |
| 36 | Samkhuwasabha, Chinpur | $27^0$ | 17' | $87^0$ | 20' | 1329 | 173 | 1683 | 1745 | 1392 | 1332 | 1521 | 2395 | 1249 | 1348 | 1669 | 1327 | 1275 |
| 37 | Saptari Rajbiraj | $26^0$ | 33' | $86^0$ | 45' | 91 | 182 | 2024 | 1763 | 2185 | NA | NA | NA | 1212 | 951 | 1141 | 1680 | 969 |
| 38 | Sindhuli, Sindhilighadi | $27^0$ | 17' | $88^0$ | 58' | 1463 | 2787 | 2919 | 2617 | NA | NA | NA | 1711 | 1279 | 1543 | NA | 2263 | 1822 |
| 39 | Sunsari, Dharan | $26^0$ | 49' | $87^0$ | 17' | 444 | 2616 | 2214 | 2325 | 2326 | 2027 | 1751 | 2167 | 2280 | 1887 | 2711 | 1637 | 1836 |

Table 8. Annual Rainfall by Station (mm)

| S. N. | Station | Latitude | | Longitude | | Elevation (masl) | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | Surkhet, Birendranagar | $28^0$ | 36' | $81^0$ | 37' | 720 | 1722 | 1538 | 1849 | 1425 | 1810 | 1485 | 1864 | 1508 | 1726 | 1975 | 1659 | 1173 |
| 41 | Syangja, Syangja | $28^0$ | 06' | $83^0$ | 53' | 868 | 3260 | 3861 | 3328 | 3114 | 2249 | 2675 | 3498 | NA | 2979 | 2904 | 2832 | 2735 |
| 42 | Tanahaun, Khairenitar | $28^0$ | 10' | $84^0$ | 00' | 823 | 227 | 3058 | 2056 | 2113 | 2089 | 2202 | 2151 | 2122 | 2979 | 1877 | 2406 | 2026 |
| 43 | Taplejung, Taplejung | $27^0$ | 21' | $87^0$ | 40' | 1732 | 1912 | 2173 | 2505 | 1746 | 1795 | 2147 | 2055 | 1766 | 1409 | 2233 | 1435 | 2006 |

Table 9. Average Sunshine Duration by Station (hr/day)

| S. N. | District / Station Name | Latitude | | Longitude | | Elevation (masl) | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Banke, Nepalganj | $28^0$ | 06' | $81^0$ | 40' | 165 | NA | NA | NA | 7.40 | 7.30 | 6.90 | 7.70 | 7.30 | 7.39 | 7.46 |
| 2 | Bara, Simara Airport | $27^0$ | 10' | $84^0$ | 59' | 130 | 7.10 | 7.10 | 7.80 | 7.20 | 6.90 | 7.60 | 7.30 | 7.30 | NA | 7.27 |
| 3 | Dadeldhura, Dadeldhura | $29^0$ | 18' | $80^0$ | 35' | 1848 | 7.50 | 8.00 | 7.20 | NA | 7.30 | 6.70 | 7.70 | 7.30 | 6.6 | 6.4 |
| 4 | Dhankuta, Dhankuta | $26^0$ | 59' | $87^0$ | 21' | 1210 | 6.90 | NA | 6.80 | 6.70 | 6.40 | 6.70 | 6.90 | 6.70 | 6.38 | 7.33 |
| 5 | Doti, Dipayal | $29^0$ | 15' | $80^0$ | 57' | 617 | 6.80 | NA | 6.70 | 6.70 | NA | 6.80 | 7.30 | 7.70 | 5.65 | 6.68 |
| 6 | Jumla, Jumla | $29^0$ | 17' | $82^0$ | 14' | 2300 | 6.90 | NA | 7.20 | NA | NA | 6.70 | 7.60 | 7.40 | 6.37 | 7.79 |
| 7 | Kaski, Pokhara Airport | $28^0$ | 13' | $83^0$ | 48' | 827 | 6.60 | 6.40 | 6.50 | 6.60 | 6.30 | 6.40 | NA | 6.40 | NA | NA |
| 8 | Kathmandu Airport | $27^0$ | 42' | $85^0$ | 22' | 1336 | NA | 5.60 | 6.00 | 6.10 | 5.50 | 6.00 | 6.40 | 6.35 | 5.93 | 6.72 |
| 9 | Morang, Biratnagar Airport | $26^0$ | 29' | $87^0$ | 16' | 72 | 6.70 | NA | 7.40 | 6.80 | 6.40 | 6.50 | 6.50 | 6.10 | 6.04 | 7.1 |
| 10 | Okhaldhunga, Okhaldhunga | $27^0$ | 19' | $86^0$ | 30' | 1720 | 6.00 | NA | 5.80 | 6.10 | 5.40 | 6.20 | 6.60 | 6.00 | 6.07 | 6.51 |
| 11 | Rupandehi, Bhairahawa Airport | $27^0$ | 31' | $83^0$ | 26' | 109 | NA | NA | 7.30 | 7.10 | 6.90 | NA | 7.60 | 7.40 | NA | NA |

Table 9. Average Sunshine Duration by Station (hr/day)

| S. N. | District / Station Name | Latitude | | Longitude | | Elevation (masl) | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | Surkhet, Birendranagar | $28^0$ | 36' | $81^0$ | 37' | 720 | NA | NA | NA | NA | 6.90 | 6.80 | 7.40 | 7.20 | 7.4 | 7.73 |
| 13 | Taplejung, Taplejung | $27^0$ | 21' | $87^0$ | 40' | 1732 | NA | NA | NA | 6.10 | NA | 6.00 | 6.80 | 6.30 | 5.86 | 6.52 |
| 14 | Kailali, Dhangadhi | $28^0$ | 41' | $80^0$ | 41' | 170 | 6.50 | NA | 7.00 | 7.10 | 6.60 | 6.30 | 7.50 | 6.80 | 6.57 | 6.77 |
| 15 | Lalitpur, Khumaltar | 27° | 40’ | 85° 20’ | | 1350 | 5.80 | 6.20 | 6.60 | 6.60 | 5.70 | 6.30 | 6.50 | 6.60 | 6.16 | 6.8 |

Source: Department of Hydrology and Meteorology.

Table 10. Average Wind Speed by Station

| S. N. | Station Name | Year | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| 1 | Arghakhanchi (Khanchikot) | NA | NA | NA | 6.7 | 5.6 | 6.6 | NA | NA | NA | NA | NA | NA | NA |
| 2 | Bardia (Chishapani) | NA | NA | NA | NA | NA | 7.2 | NA | NA | NA | NA | NA | NA | NA |
| 3 | Rupandehi, Bhairahawa Agriculture | 2.8 | NA | 2.7 | 2.5 | 2.8 | 2.7 | 2.7 | NA | NA | NA | NA | NA | NA |
| 4 | Bhojpur, Bhojpur* | 0.7 | 0.7 | 0.8 | 1.2 | - | - | - | - | - | - | - | - | - |
| 5 | Dadeldhura, Dadeldhura | 3.1 | 2.2 | 1.8 | 1.8 | 2.3 | 3.4 | 2.9 | 2.6 | 2.6 | 2.8 | NA | 2.11 | NA |
| 6 | Dhankuta, Pakhribas | NA | NA | 1.1 | 0.8 | 1.3 | 1.2 | 1.3 | N. A | 0.9 | NA | NA | NA | NA |
| 7 | Dhankuta, Dhankuta | 4.2 | 4.1 | 4.1 | 3.8 | 3.9 | 3.9 | 3.5 | 3.2 | 3.3 | 3.1 | 2.9 | 2.51 | 2.54 |
| 8 | Dolakha (Jiri) | NA | NA | NA | 2.5 | 2.9 | 3.2 | 3.1 | NA | 3.0 | NA | 3.2 | 2.92 | NA |
| 9 | Doti, Dipayal | NA | NA | 1.1 | 0.9 | 0.8 | 1.4 | 2 | 1.9 | 1.5 | 1.6 | NA | NA | NA |
| 10 | Ilam, Ilam Tea State | NA | NA | NA | NA | NA | 1.2 | 1.2 | NA | NA | NA | NA | NA | NA |
| 11 | Jhapa, Kankai Gaida | 1.4 | 1.2 | 1.2 | 1.0 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 12 | Mustang, Jomsom | NA | NA | NA | 15.6 | 16.1 | NA | NA | NA | NA | NA | NA | NA | NA |

Table 10. Average Wind Speed by Station

| S. N. | Station Name | Year | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| 13 | Jumla, Jumla | NA | NA | 5.8 | 5.2 | 6.0 | 5.4 | 5.6 | 5.3 | 4.6 | 4.8 | 4.4 | 4.16 | |
| 14 | Kailai, Dhangadhi | NA | NA | NA | NA | NA | NA | NA | 1.7 | 1.7 | 1.6 | NA | NA | NA |
| 15 | Kanchanpur, Mahendranagar | 1.9 | 1.9 | 1.9 | NA | 1.8 | 2.4 | 2.1 | NA | NA | NA | NA | NA | NA |
| 16 | Kaski, Lumle | 1.4 | 1.3 | 1.1 | 1.1 | 1.1 | 1.3 | 1.3 | 1.4 | 1.2 | 0.8 | 0.7 | 0.76 | NA |
| 17 | Kathmandu, Kathmandu Airport | 1.0 | 0.8 | 1.0 | 0.9 | 0.8 | 0.8 | NA | 0.7 | 0.9 | 0.6 | 0.6 | | NA |
| 18 | Lalitpur, Khumaltar | 3.1 | 3.1 | 2.8 | 3.1 | 3.1 | 3.0 | 3.0 | 3.0 | 3.2 | 3.0 | 3.0 | 2.68 | NA |
| 19 | Kaski, Malepatan | 1.0 | 0.7 | 0.7 | 0.5 | 0.3 | 0.3 | 0.3 | 0.4 | 0.3 | 0.2 | 0.28 | NA | NA |
| 20 | Morang, Biratnagar Airport | 1.5 | 1.1 | 2.2 | 2.8 | 2.0 | 1.8 | NA | 5.9 | 6.5 | 5.0 | 2.8 | 1.24 | 2.25 |
| 21 | Bhaktpur, Nagarkot | 6.2 | NA | NA | 5 | 4.4 | 4.3 | 3.7 | 2.9 | 2.7 | 0.9 | NA | NA | NA |
| 22 | Banke, Nepalganj | NA | 2.4 | 2.6 | 2.5 | 2.6 | 2.8 | 2.0 | 1.9 | 1.5 | 1.6 | NA | NA | NA |
| 23 | Banke, Khajura | NA | NA | 1.6 | 1.7 | 1.9 | 2.2 | 1.9 | 1.9 | 1.9 | 1.8 | NA | NA | NA |
| 24 | Banke, Sikta | NA | NA | 1.3 | 1.6 | 1.6 | 1.9 | 1.5 | 0.6 | 0.8 | 0.6 | NA | 1.49 | NA |
| 25 | Okhaldhunga, Okhaldhunga | 3.6 | 2.8 | 4.1 | 3.4 | 2.3 | 2.7 | 4.3 | 4.3 | 3.8 | 2.0 | 2.3 | 2.03 | 4.76 |
| 26 | Parsa, Parwanipur | 2.3 | NA | 2.1 | 2.0 | 2.2 | 2.5 | 1.7 | 0.7 | 1.3 | -0.4 | 0.5 | NA | NA |
| 27 | Kaski, Pokhara Airport | 2.7 | 2.4 | 2.1 | 2.4 | 2.3 | 2.3 | NA | 1.9 | 2.1 | 2.3 | NA | 2.57 | NA |
| 28 | Siraha, Lahan | NA | NA | 3.1 | 3.5 | 3.3 | 3.9 | NA | NA | 1.9 | 1.1 | NA | NA | NA |
| 29 | Sunsari, Tarahara | NA | NA | 3.9 | 4.5 | 4.0 | 4.5 | 7.0 | 6.4 | 6.2 | NA | 6.3 | NA | NA |
| 30 | Surkhet, Birendranagar | 2.1 | 2.1 | 2.0 | 1.7 | 1.5 | 1.6 | 1.2 | 1.3 | 1.6 | 1.0 | NA | NA | NA |
| 31 | Surkhet, Pusmacamp | 1.8 | NA | 2.1 | 1.9 | 1.7 | 1.6 | 1.9 | 1.6 | NA | NA | NA | NA | NA |
| 32 | Taplejung, Taplejung | 2.5 | 3.1 | 3.0 | NA | 2.6 | 2.5 | NA | 1.5 | 1.8 | 1.7 | 1.7 | 1.68 | 1.68 |

NA = not available (Station has been closed since 2004) Source: Department of Hydrology and Meteorology.

Table 11. Annual Mean Temperature by Station

| S.N. | District / Stations Name | Latitude | | Longitude | | Elevation (masl) | Mean Temperature ($^0$ C) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| 1 | Banke, Nepalgan | 27$^0$ | 06' | 81$^0$ | 40' | 165 | 22.6 | 25.1 | 25.5 | 25.6 | 24.2 | 24.3 | 24.6 | 24.8 | 24.3 | 24.8 |
| 2 | Bara, Simara Airport | 27$^0$ | 10' | 84$^0$ | 59' | 130 | 23.8 | 24 | 24.5 | 24.4 | 24.3 | 24.4 | 24.9 | 25 | NA | 24.4 |
| 3 | Bhaktapur, Nagarkot | 27$^0$ | 42' | 84$^0$ | 59' | 2163 | 9.9 | 8.8 | 9.2 | 8.6 | 14.6 | 14.5 | 14.6 | 15.1 | 14.5 | 14.6 |
| 4 | Bhojpur, Bhojpur* | 27$^0$ | 11' | 85$^0$ | 13' | 1595 | - | - | - | - | - | - | - | - | - | - |
| 5 | Chitawan, Rampur | 27$^0$ | 37' | 84$^0$ | 25' | 256 | 24.4 | 24.5 | 24.7 | 24.9 | 24.5 | 24.3 | 24.8 | 24.8 | NA | 22.2 |
| 6 | Dadeldhura, Dadeldhura | 29$^0$ | 18' | 80$^0$ | 35' | 1848 | 16.6 | 16.8 | 16.5 | 17.4 | 17.0 | 16.8 | 17.4 | 17.5 | NA | 17.6 |
| 7 | Dailekh, Dailekh | 28$^0$ | 51' | 81$^0$ | 43' | 1402 | 18.8 | 19.2 | 18.9 | 17.9 | 19.1 | 20.2 | 20.2 | 20.1 | 20.2 | 21.3 |
| 8 | Dang, Ghorahi | 28$^0$ | 03' | 82$^0$ | 30' | 634 | 21.5 | 21.9 | 22.4 | 22.5 | 21.9 | 22.0 | 22.7 | NA | NA | NA |
| 9 | Darchula, Darchula | 29$^0$ | 51' | 80$^0$ | 34' | 1097 | 20.7 | 21.0 | 20.1 | 21 | 20.3 | 20.4 | 21.3 | 21.5 | 22.3 | NA |
| 10 | Dhankuta, Dhankuta | 26$^0$ | 59' | 87$^0$ | 21' | 1210 | 19.8 | 19.7 | 19.9 | 20.4 | 20.1 | NA | 20.6 | 20.9 | 20.1 | 20.7 |
| 11 | Dolakha, Jiri | 27$^0$ | 38' | 86$^0$ | 14' | 2003 | 14.3 | 14.3 | 14.2 | 14.9 | 5.3 | 14.3 | 14 | NA | 14.2 | 14.5 |
| 12 | Dolpa, Dunai | 28$^0$ | 56' | 82$^0$ | 55' | 2058 | 16.5 | 15.7 | 13.8 | NA | 14.4 | NA | NA | NA | NA | NA |
| 13 | Doti, Dipayal | 29$^0$ | 15' | 80$^0$ | 57' | 617 | 23.5 | 23.8 | 22.6 | 22.9 | 22.5 | 22.3 | 22.8 | 23.0 | 23.7 | 24.0 |
| 14 | Gorkha, Gorkha | 28$^0$ | 00' | 84$^0$ | 37' | 1097 | 20.8 | 17.1 | 20.2 | 22.7 | 22.0 | 22.9 | 21.9 | 22.5 | 22.2 | 21.8 |
| 15 | Gulmi, Tamghas | 28$^0$ | 04' | 83$^0$ | 15' | 1530 | 17.1 | 17.6 | 17.6 | 18.1 | 17.4 | NA | 18.0 | 18.5 | 17.7 | 17.8 |
| 16 | Ilam, Ilam Tea State | 26$^0$ | 55' | 87$^0$ | 54' | 1300 | 15.7 | NA | 16.8 | 20.2 | 23.5 | NA | 20.4 | NA | NA | NA |
| 17 | Dhanusha, Janakpur Airport | 26$^0$ | 43' | 85$^0$ | 58' | 90 | 24.6 | 24.8 | 25.2 | 25.3 | 25.0 | 25.0 | 25.5 | 25.4 | NA | 25.1 |
| 18 | Jhapa, Kankai | 26$^0$ | 35' | 87$^0$ | 54' | 143 | 24 | 24.5 | 25 | 25 | 24.5 | 24.6 | 24.8 | 24.9 | 24.4 | 24.2 |
| 19 | Mustang, Jomsom | 28$^0$ | 47' | 83$^0$ | 43' | 2744 | 11.6 | 12.1 | 11.8 | 12.3 | 11.9 | 11.5 | 11.8 | 12 | 11.4 | 11.2 |
| 20 | Jumla, Jumla | 29$^0$ | 17' | 82$^0$ | 14' | 2300 | 13.1 | 13.4 | 12.9 | 13.9 | 13.5 | 13.3 | 13.7 | 13.7 | 13.1 | 12.8 |
| 21 | Kailali, Dhangadi | 28$^0$ | 41' | 80$^0$ | 41' | 170 | 15 | 14.7 | 15 | 15.1 | 24.0 | 24.0 | 24.4 | 24.5 | 24.0 | 24.2 |
| 22 | Kanchanpur, Mahendera | 29$^0$ | 02' | 80$^0$ | 13' | 176 | 21.1 | 23.8 | 24.2 | 24.3 | 24.8 | NA | 24.4 | 24.6 | NA | NA |
| 23 | Kaski, Lumle | 28$^0$ | 18' | 84$^0$ | 00' | 1740 | 16.5 | 16.2 | 16.2 | 20.7 | 16.4 | 16.4 | 17.1 | 17.1 | 16.2 | 16.6 |

Table 11. Annual Mean Temperature by Station

| S.N. | District / Stations Name | Latitude | | Longitude | | Elevation (masl) | Mean Temperature ($^0$ C) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| 24 | Kaski, Pokhara Airport | 28$^0$ | 13' | 83$^0$ | 48' | 827 | 21.5 | 21.6 | 21.4 | 22 | 21.4 | 21.3 | 22.1 | 22.0 | 21.0 | 21.4 |
| 25 | Kathmandu Airport | 27$^0$ | 42' | 85$^0$ | 22' | 1336 | 19.2 | 19.2 | 19.4 | 19.8 | 19.5 | 19.5 | 20.0 | 20.3 | 19.3 | 19.3 |
| 26 | Lamjung, Khudibazar | 28$^0$ | 17' | 84$^0$ | 22' | 823 | 23 | 23.2 | 23.7 | 24.6 | 21.4 | 21.0 | 21.8 | 22.4 | 21.3 | 21.1 |
| 27 | Makawanpur, Hetauda | 27$^0$ | 25' | 85$^0$ | 03' | 474 | 22.5 | 22.3 | 23.1 | 23.7 | 23.3 | 23.4 | 24 | 23.8 | NA | 23.2 |
| 28 | Manang, Chame | 28$^0$ | 33' | 84$^0$ | 14' | 2680 | NA | 11.5 | 10.8 | 11.6 | 11.2 | 10.6 | 10.5 | 10 | 10.6 | NA |
| 29 | Morong, Biratnagar Airport | 26$^0$ | 29' | 87$^0$ | 16' | 72 | 24.3 | 24.5 | 25.2 | 25.2 | 24.9 | 24.9 | 25.2 | 25.2 | 24.7 | 24.9 |
| 30 | Nawalparasi, Dumkauli | 27$^0$ | 41' | 84$^0$ | 13' | 154 | 24.2 | 24.4 | 24.8 | 24.9 | 24.6 | 24.7 | 25.1 | 25.1 | 24.4 | 24.3 |
| 31 | Nuwakot, Nuwakot | 27$^0$ | 55' | 85$^0$ | 10' | 1003 | NA | NA | 21.5 | 22.5 | 22.1 | 22.0 | 22.7 | NA | NA | 22.2 |
| 32 | Okhaldhunga, Okhaldhunga | 27$^0$ | 19' | 86$^0$ | 30' | 1720 | 17.5 | 17.4 | 17.4 | 18 | 17.3 | 17.5 | 18.1 | 18.1 | 17.2 | 16.5 |
| 33 | Palpa, Tansen | 27$^0$ | 52' | 83$^0$ | 33' | 1343 | 14.1 | 20.5 | 20.1 | 21 | 21.0 | 20.2 | 20.4 | 19.9 | 20.5 | 20.0 |
| 34 | Rautahat, Gaur | 27$^0$ | 11' | 85$^0$ | 10' | 244 | 24.8 | 24.7 | 24.5 | 26.1 | 25.6 | 26.1 | 21.8 | 20.4 | NA | 19.1 |
| 35 | Rupandehi, Bhairahawa | 27$^0$ | 31' | 83$^0$ | 26' | 109 | 24.5 | 24.8 | 25.2 | 25.3 | 25.0 | 24.9 | 25.3 | 25.2 | 24.7 | 25.0 |
| 36 | Saptari Rajbiraj | 26$^0$ | 33' | 86$^0$ | 45' | 91 | 22 | 23.8 | 25.7 | 25.2 | 23.7 | 25.7 | 25.1 | 25.1 | 24.2 | 24.6 |
| 37 | Samkhuwasabha, Chainpur | 27$^0$ | 17' | 87$^0$ | 20' | 1329 | 19.3 | 18.1 | 17.9 | 18 | 17.9 | 18.6 | 19.2 | NA | 18.6 | 19.1 |
| 38 | Sunsari, Dharan | 26$^0$ | 49' | 87$^0$ | 17' | 444 | 23.7 | 24.1 | 23.5 | 25 | 24.3 | 24.6 | 25.3 | 25.2 | 24.4 | 24.4 |
| 39 | Surkhet, Birendranagar | 28$^0$ | 36' | 81$^0$ | 37' | 720 | 21.7 | 22 | 22 | 22.4 | 21.8 | 21.9 | 22.3 | 22.9 | 22.5 | 22.4 |
| 40 | Syangja, Syangja | 28$^0$ | 06' | 83$^0$ | 53' | 868 | 20.9 | 21.1 | 20.7 | 21.5 | 21.1 | 20.7 | 21.6 | 21.6 | 20.9 | 21.0 |
| 41 | Tanahaun, Khairenitar | 28$^0$ | 10' | 84$^0$ | 00' | 823 | 23 | 23.2 | 23.7 | 24.6 | 23.7 | 23.3 | 23.8 | 23.8 | 23.3 | 23.1 |
| 42 | Taplejung, Taplejung | 27$^0$ | 21' | 87$^0$ | 40' | 1732 | 16.4 | 16.3 | 16.9 | 17.2 | 16.9 | 16.9 | 17.4 | 17.6 | 16.9 | 16.9 |

(NA= Not Available; masl = meter above sea level * Station has been closed since 2004)
Source: Department of Hydrology and Meteorology

Figure 12 shows graphically the percentage of area in each physiographic region.

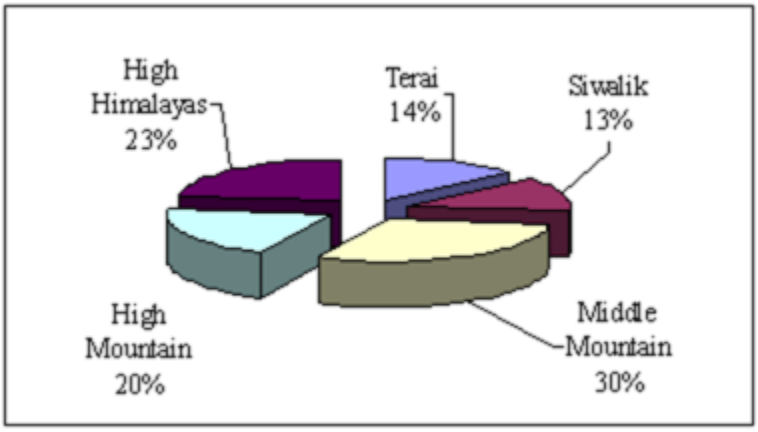


Figure 12. Percentage of Nepal's Area in the Five Physiographic Zones
Source: FAO, 2000.

Table 12 presents the profile of the area in each of these regions. The Tarai zone is the southernmost zone and a flat, fertile and intensively cultivated area. The Siwalik zone is very rugged and regularly affected by floods and landslides. The middle mountain zone is rugged but heavily cultivated and supports a large part of the population. The high mountain zone lies below the snow line. The high Himalayan zone is the northern most zone, extending over the highest Himalayan peaks.

Table 12 .Profile of the Physiographic Zones

| Main items | Tarai | Siwalik | Middle Mountain | High Mountain | High Himal |
|---|---|---|---|---|---|
| Geology | Quaternary alluvium. | Tertiary sandstone, siltstone, shale and conglomerates | Phyllite, quartzite limestone & islands of granites | Gneiss, quartzite & mica shists | Gneiss, schist, limestone and Tethys sediments |
| Elevation | 60-330 m. subtropical | 200-1 500 m. | 800-2 400 m. Relief 1 500 m with isolated peaks to 2 700 m | 2 200-4 000 m. High relief 3 000 m from valley floor to ridges Warm to cool temperate | 4 000 m+ |
| Climate | Subhumid in FW+MWDR; humid in W+C and EDR | Subtropical (but warm temperate in | Warm temperate (but subtropical in | Warm to cool temperate | Alpine to Arctic (snow 6-12 months) |

Table 12 .Profile of the Physiographic Zones

| Main items | Tarai | Siwalik | Middle Mountain | High Mountain | High Himal |
|---|---|---|---|---|---|
| | | higher hill spurs) | lower river valleys and cool temperate on high ridges | | |
| Moisture Regime | Subhumid in FW+MWDR; humid in W+C and EDR | Subhumid in most of the area; humid in N-aspect of W+C+EDR and Dun valleys | Subhumid; humid above 2000 m N-aspects and 1000 m S-aspects | Subhumid N-aspects; humid throughout the region below 3 600 m | |
| Rainfall intensity | High | High | Medium | Low | Low |
| Vegetation | Sal + mixed hardwoods | Sal + mixed hardwoods + pine forest | Pine forest + mixed hardwood and oak forest | Fir, pine, birch and rhododendron | Open meadows + tundra vegetation |
| Soils | Ustochrepts, Haplustolls, Haplaquepts, Haplustalfs, Ustifluvents & Ustorthents | Ustochrepts, Haplustolls, Rhodustalfs, Ustothents, Dystrochrepts, Haplaquepts & Ustifluvents. | Ustochrepts, Haplustalfs, Rhodustalfs, Haplumbrepts, Ustorthents & Ustifluvents | Eutrochrepts, Dystrochrepts, Haplumbrepts, Cryumbrepts, Cryorthents & Ustorthents | Cryumbrepts, Cryorthents & Rock |
| Crops | Rice, maize, wheat, mustard, sugarcane, jute, tobacco, cotton, tea | Rice, maize, wheat, millet, radish, potato, ginger, tea. | Rice, maize, wheat, millet, barley, pulse, sugarcane, radish, potato, ginger, cardamom. | Oat, barley, wheat, potato, buckwheat, yams, amaranthus, medicinal herbs | Grazing (June-Sept.) |
| Horticulture | Mango, litchi, pineapple, jackfruit, imli, palm | Mango, papaya, banana, moringa. | Mango, papaya, banana, orange, lime, lemon, peach, plum, aegal, pomegranate | Chestnut, walnut, apple, peach, plum, apricot | |
| People | Tharus, Brahmins, Chhetris, | Tharus (Dun valley) presently | Gurungs, Magars, | Khas chhetris, Tibetean related | Temporary herders & |

Table 12 .Profile of the Physiographic Zones

| Main items | Tarai | Siwalik | Middle Mountain | High Mountain | High Himal |
|---|---|---|---|---|---|
| | Mohammedan | all hill tribes immigrated from Middle Mountain | Tamangs, Newars, Brahmins, Chhetris, Damais, Sarkis, Sunars, Kumals, Rais, Limbus | groups-Thakalis, Bhotias, Sherpas, Tamangs, Ghales | Sherpas (in East Nepal) |
| Industry | Matches, jute, cigarette & sugar factories, saw mills, rice & flour mills, soaps, consignments, food processing, furniture, industrial estates. | Saw mills, rice, flour & oil mills, industrial estates, cotton factory; cement factory and wildlife camps. | Rice, flour & oil mills, cement factory, industrial estates, cottage industry-handicrafts, curios, hosiery, plastics, hotels & lodges. | Cottage industry-carpets, blankets, hard woven cloths, trekking & expeditions. | Mountaineering expeditions & trekking. |

Source: FAO: 2000.

The extremes in altitudinal gradient have produced six bio-climatic zones ranging from tropical to nival within a short horizontal span. The Tarai belt with low elevations ranging from 67-300 masl, is a flat stretch of fertile agricultural and forested land, which forms part of the alluvial Gangetic plain and is characterized by many complex and diverse riverine ecosystems, many now well represented in protected areas such as Chitwan National Park. The Siwalik Hills Zone, with elevation between 700 and 1500 m, rises abruptly from the Tarai plains and is mainly composed of sedimentary rock with large boulders.[59] The Mahabharat Lek, at elevation 1500 to 2700 masl, lies between the Siwalik Hills to the south and the midlands to the north. The Midlands, with an average altitude of 2000 masl, occupy the central region of the country. This area is characterized by many small farming communities usually on terraced hill slopes, set among extensive forests grading from oak at lower altitudes to fir, birch and rhododendron at higher altitudes. The Himalayan zone, above 4000 masl, lies in the north and stretches from east to west of the country. It consists of subalpine and alpine climates where summer grazing pastures are found in the lower elevations, and high altitude plant species adapted to extremes of cold and desiccation grow in rain shadow areas at higher elevations. There are several inner Himalayan valleys with desert conditions such as the upper Kaligandaki and Bheri valleys located at altitudes above 3600 masl.[60]

[59] 2000 FAO. FRA 2000 - Forest Resources of Nepal, Country report
[60] Ibid.

### 4.1.3 Soil

Soil formation is generally related to the physiographic zone and climatic conditions.

The Tarai region consists of recent and post Pleistocene alluvial deposits that form a piedmont plain and the soil is alluvial and fine to medium textured. In the Siwalik Hills, the soil is made up of sedimentary rocks with a sandy texture. In the Mid-hills the soil is moderately to highly acidic, medium to light in texture, while the dominant soil texture found in Middle Mountains region ranges from fragmented sandy to loamy/boulderly, loamy, loamy skeletal as per the diverse land forms with a predominance of coarse grained sand and gravel.[61]

Fine particles of stony soil exist in cracks of larger rocks in the High Himalayan region. The high Himalayan physiographic region is characterized by rocky soils originated from gneiss, schist, limestone and shale of different ages and shallow and stony soils are seen in the high mountains.[62]

The lower Churia is largely composed of very fine-grained sediments such as variegated mudstone, siltstone and shale with smaller amounts of fine-grained sandstone. The middle Churia has thick beds of multi-storied sandstones alternating with subordinate beds of mudstone. The upper Churia is characterized by very coarse sediments such as loose boulder conglomerates.[63]

The soil types in Nepal have been categorized under 16 classes and these are presented in Figure 13.

### 4.1.4 Topography

Elevation is the main factor that defines the boundaries of the five physiographic regions that run as horizontal bands stretching from east to west across Nepal's 800-km length. Around 43% of the land is above 3,000 masl and is mostly unsuitable for agriculture or production forestry. Only 14% of the land area is less than 500 masl, which is mainly in the Tarai area. Middle mountain area comprises 30%, while the Siwalik area is approximately 13%.

[61] DFRS, 2015. State of Nepal's Forests. Forest Resource Assessment (FRA) Nepal, Department of Forest Research and Survey (DFRS). Kathmandu, Nepal
[62] Ibid.
[63] Ibid.

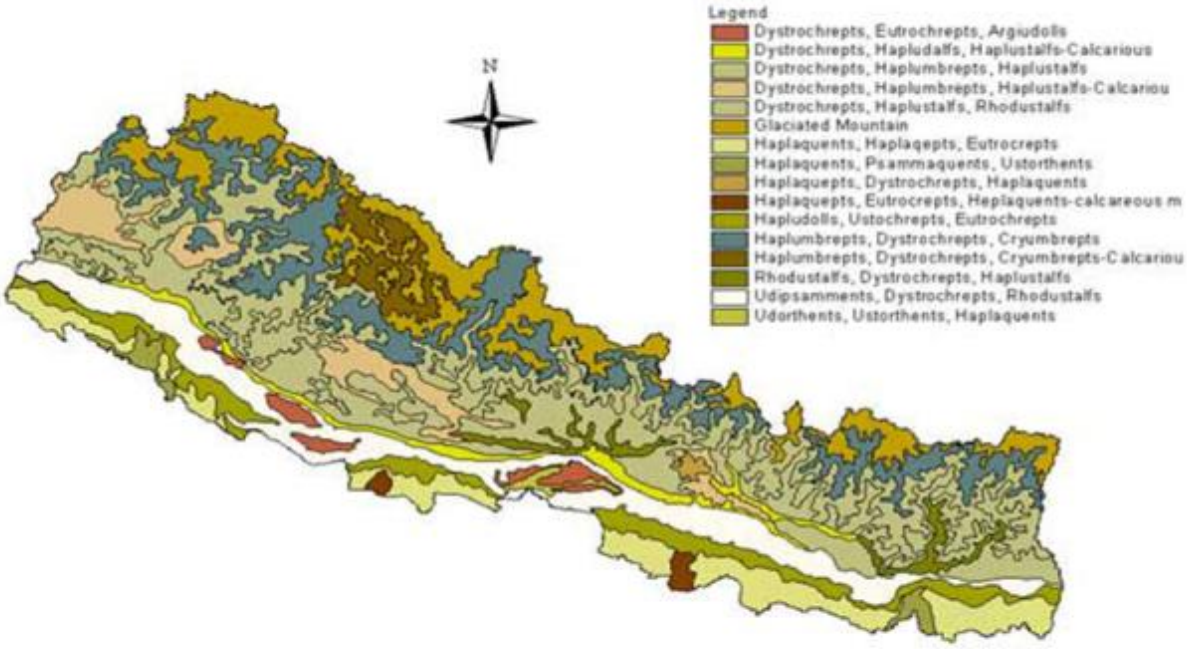


**Figure 13. Soil map of Nepal**
Source:https://www.google.com.au/search?q=Soil+Map+of+Nepal&biw=1280&bih=591&site=webhp&tbm=isch&imgil=3xy1OFUGuXuHWM%253A%253BRT, Accessed 15 Nov 2016

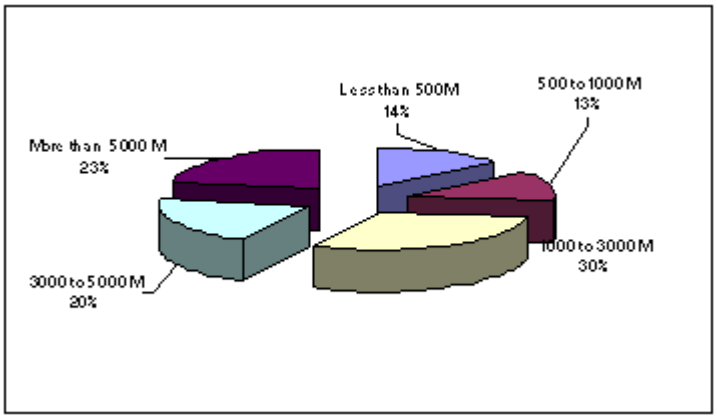


**Figure 14. Distribution of Area by Altitude**
Source: FAO, 2000.

### 4.1.5 Geology

The Himalaya was formed due to a collision of the Indian Plate and Eurasian Plate about 40 million years ago. It extends 2400 km in an east-west direction. Its width varies from 230 to 320 km and is bounded between the Indo-Gangetic Plain in the south and Tibetan Plateau in the north. Nepal Himalaya occupies the central 800 km part. It can be divided into five distinct morpho-geotectonic zones, from south to the north: 1) Tarai Plain 2) Sub Himalaya (Siwalik Range), 3) Lesser Himalaya (Mahabharat Range and mid valleys), 4) Higher Himalaya, and 5) Inner Himalaya (Tibetan Tethys).[64] Each of these zones is clearly identified by its morphological, geological and tectonic features.

The Main Frontal Thrust, Main Boundary Thrust, Main Central Thrust, and South Tibetan Detachment Fault System, from south to the north respectively, are the major linear geological structures that act as the boundary line between the two consecutive units.[65] The High Himalayan zone belongs to the Precambrian era, which consists of gneiss, schist, limestone and sediments. The High Mountain zone belongs to the Precambrian era and consists of metamorphic rocks such as gneiss and schist. This zone also possesses granite and pegmatite. The Middle Mountain zone is mostly of late Precambrian to Devonian era and consists of phyllite, quartzite, gneiss, granite and schist. The Siwalik zone belongs to the middle Paleocene and early quaternary period and mainly consists of shale, sandstone, and conglomerate. Finally, the Tarai zone is composed of fine alluvial materials.

Considering mineral resources, Tarai Plain has the potential for gravel, sand, ground water and petroleum. The Sub-Himalaya area has potential for construction materials, petroleum and natural gas. Similarly, the Lesser Himalaya is promising for metallic minerals, industrial minerals, marble, gemstones, fuel minerals and construction materials. Some of the areas in Higher Himalaya are highly promising for precious and semiprecious stones, marble and metallic minerals. Tibetan Tethys zone is prospective for limestone, gypsum, brine water (salt) and natural gas.[66]

### 4.1.6 Water Resources

Water is the most plentiful natural resource in Nepal, the major sources of which are glaciers, rivers, rainfall, lakes, ponds, and groundwater. Of these, rivers are the largest source in terms of water volume and potential development. There are over 6,000 rivers in the country with an estimated total length of 45,000 km. All large rivers are fed by snowmelt from the Himalayas and hence could be considered a renewable water resource. The country has 660 lakes of more than 1

[64] http://www.dmgnepal.gov.np/geology-of-nepal. Accessed 14 Nov 2016
[65] Ibid.
[66] http://www.dmgnepal.gov.np/geology-of-nepal. Accessed 14 Nov 2016

ha and the larger lakes are used for irrigation, hydropower generation, fishing, and other activities. About 75% of the total annual rainfall (average 1,700 mm) falls during the summer monsoon season (June-September) during which major agricultural activities take place.[67] Groundwater remains an important source of water, particularly in the Tarai region and Kathmandu Valley.

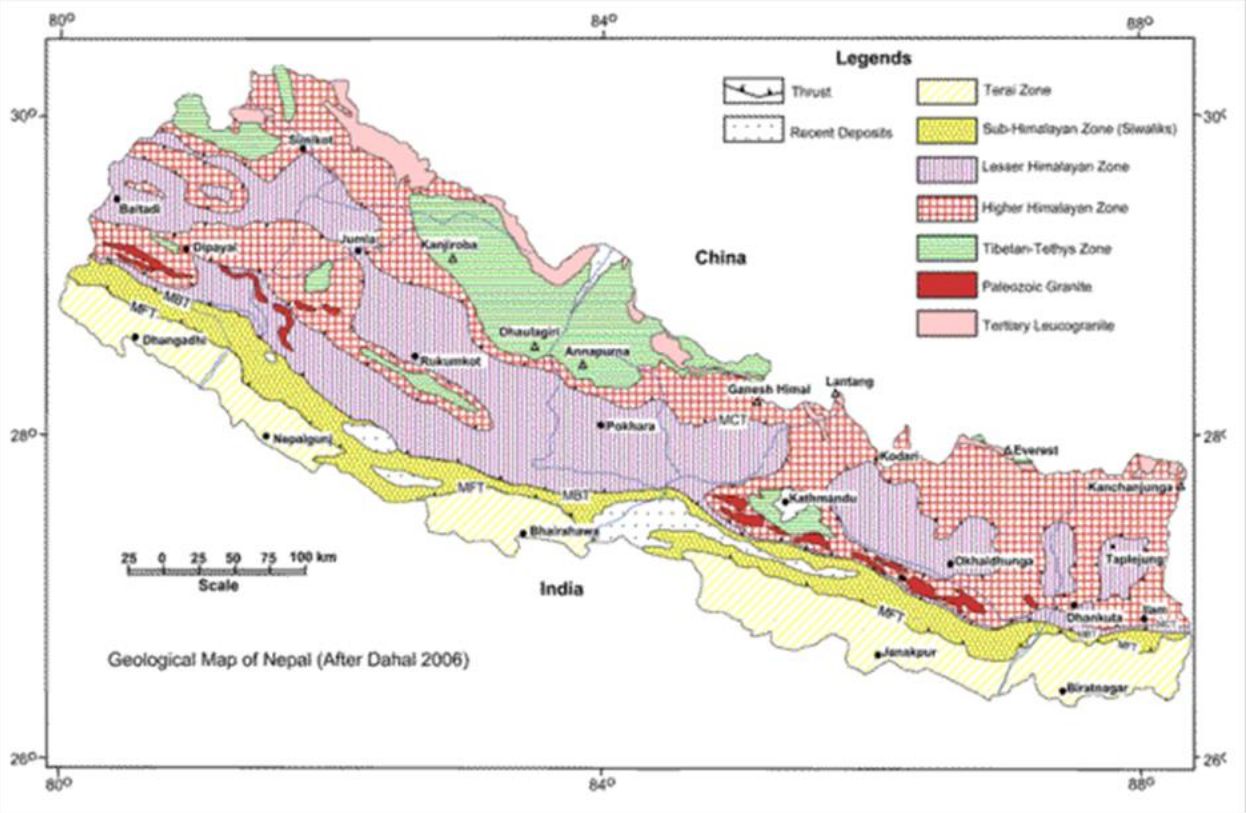


Figure 15. Geological Map of Nepal
Source: http://www.dmgnepal.gov.np/geology-of-nepal

**River Systems**

Surface water is the major source of drinking water in Nepal. The major perennial rivers of Nepal are the Koshi, the Gandaki, the Karnali, and the Mahakali, all of which originate in the Himalayas. The Koshi river basin is the largest, covering a catchment area of 60,400 km$^2$, of which 46% lies in Nepal and the remainder in Tibet Autonomous Region of the People's Republic of China. It has an average runoff equivalent to 1,409 m$^3$/sec at Chatara. Some 23% of Nepal's population lives in this

[67] Environment Assessment of Nepal: Emerging Issues and Challenges, http://www.preventionweb.net/publications/view/2728, Accessed 8 Nov 2016

river basin. The Gandaki river basin in the central region includes about 90% of the river's total catchment area. The Karnali and the Mahakali river basins lie in the west of Nepal. Some 22% of Nepal's population lives in the Karnali basin, which has a population density of 92 persons per $km^2$. The Mahakali River acts as the border between Nepal and India. About 34% of its catchment area lies in Nepal. The Babai, Bagmati, Kamala, Kankai, and West Rapti are medium-sized rivers originating from the Mahabharat range. These rivers, like the Himalayan Rivers, are perennial. The innumerable southern rivers originating from the Siwalik hill range are shallow and mostly dry up during the dry season. These rivers are used by the managed irrigation schemes of small-scale farmers for seasonal supplementary irrigation. They often swell and overflow due to monsoon rains, destroying land and lives.[68]

The Tarai region contains many small and usually seasonal rivers, most of which originate in the Siwalik Hills. These rivers hold a great potential for both small and large-scale hydro-electricity production, which could offset the need to use forests for fuel. However, this and other uses of water are threatened by the melting of glaciers as a result of global warming.

The nine major river systems with a watershed area of about 194,471 $km^2$ (see Table 13) have a total water storage capacity of about 202,000 million $m^3$ and the annual run-off contributed by them within Nepal is about 170 billion $m^3$. The Koshi, Naryani and Karnali river systems together contribute about 74% of the total runoff[69] (Figure 16). Figure 17 shows the river systems of Nepal.

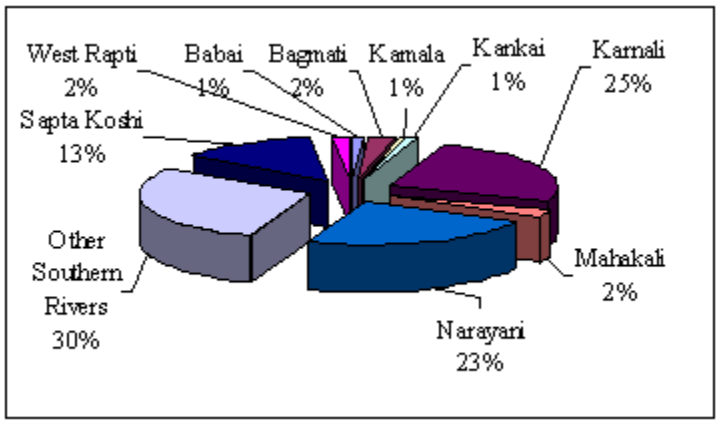


**Figure 16. Share of River Systems in Total Runoff**
Source: FAO, 2000

[68] FAO .2000. FRA.2000 - Forest Resources of Nepal, Country report
[69] Ibid.

Table 13. River Water Runoff from Nepal

| S.N. | River | Length (km) | Drainage Area (sq.km) | | Estimated Runoff ($m^3$/sec) | |
|---|---|---|---|---|---|---|
| | | | Total | Nepal | From all Basins | From Nepal |
| 1 | Mahakali | 223 | 15,260 | 5,410 | 698 | 247 |
| 2 | Karnali | 507 | 44,000 | 41,890 | 1,441 | 1,371 |
| 3 | Babai | 190 | 3,400 | 3,400 | 103 | 103 |
| 4 | West Rapti | 257 | 6,500 | 6,500 | 224 | 224 |
| 5 | Narayani | 332 | 34,960 | 28,090 | 1,753 | 1,409 |
| 6 | Bagmati | 163 | 3,700 | 3,700 | 178 | 178 |
| 7 | Sapta Koshi | 513 | 60,400 | 31,940 | 1,658 | 878 |
| 8 | Kankai | 108 | 1,330 | 1,330 | 68 | 68 |
| 9 | Other Rivers | | 24,921 | 24,921 | 1,001 | 1,001 |
| | | **Total** | 194,471 | 147,181 | 7,124 | 5,479 |

Source: Water and Energy Commission Secretariat, 2011(Water Resources of Nepal in the context of Climate Change.

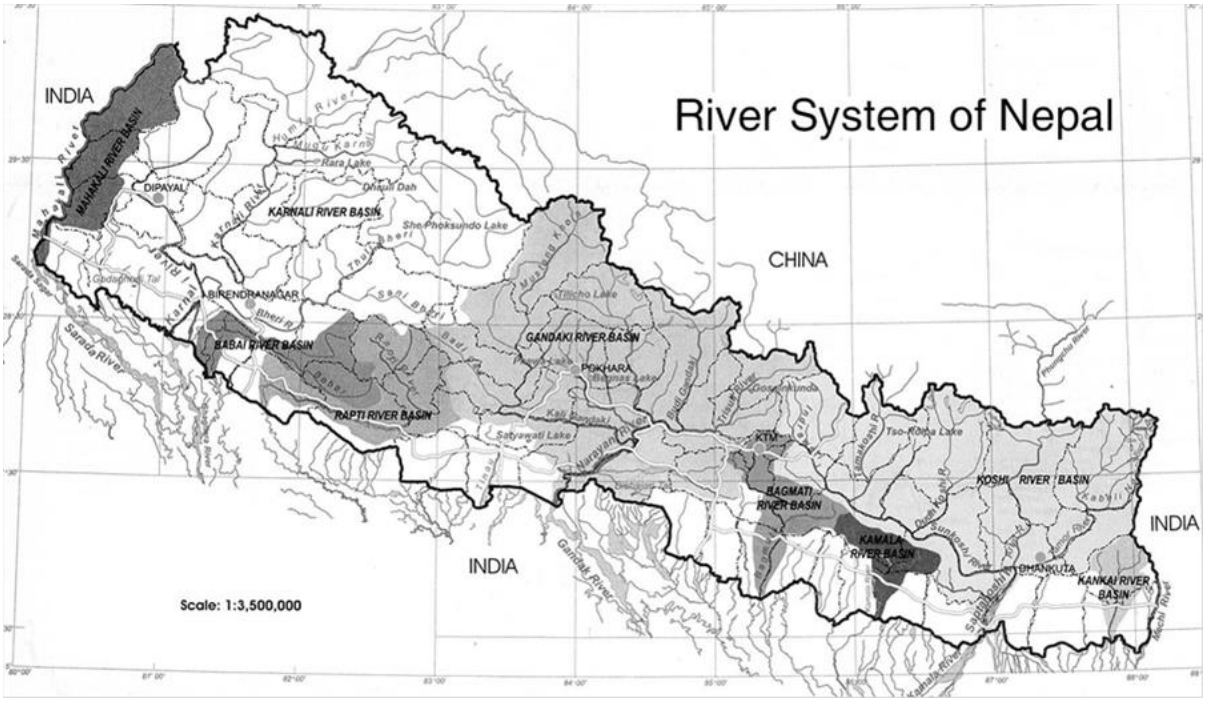


**Figure 17. River Systems of Nepal**

Source: https://bordernepal.wordpress.com/2012/06/06/rivers-of-nepal/

The Mechi River which is not included in the above table, it is an 80 km long trans-boundary river

flowing through Nepal and India[70].

Water use and quality

The country has about 224 $km^3$ of annual renewable water, and the annual per capita water supply in 2001 was 9,600 $m^3$, down from 11,000 $m^3$ in 1995. In the same year, the total annual withdrawal of water for consumptive uses (domestic, agriculture, and industry) was 14 $km^3$ and per capita annual withdrawal of water was 690 $m^3$. Although the total annual withdrawal of water increased in 2001, most of the increase went to agriculture, while the percentage used for domestic purposes decreased. Agriculture used about 96% of the total withdrawal in 2001, mostly for irrigation, with the domestic sector's share less than 4%. The use of water by the industrial sector was not very significant.

Groundwater is the best alternative source of water supply, particularly in the Tarai region and Kathmandu Valley. The total ground water potential of the country is 12 $km^3$, of which 5.8 to 11.5 $km^3$ can be extracted annually without any adverse effects. However, the level of groundwater in Kathmandu Valley is already dropping due to overexploitation. The Bhabar zone with dense forest cover, a contiguous area of the Tarai, is the recharge area for the Tarai's groundwater.[71]

In addition, river water is also used for generating hydropower. The country has 83,000 megawatts of potential hydropower generation, of which 42,000 MW are economically viable. At present, total electricity generation is around 559 MW. Further, micro hydropower plants are operated in several parts of the Hill and the Mountain regions, although their contribution to total hydropower generation remains small at 1.2%. Local streams and rivulets are also important sources of energy for agro-processing in the Hill and Mountain regions. Operation of water mills (ghattas) for grinding grain has existed for centuries; it is environmentally sound though not very profitable economically. There are about 25,000 water mills in Nepal.[72]

The quantity and quality of water directly and indirectly affect human activity, health, and sanitation. These, in turn depend, on the water sources. **Table 14** and **Table 15** show the water quality of major rivers and ground water.

Table 14. Water Quality of Major Rivers During the Dry Season

| Development Region | Location / River | pH | TDS (mg/l) | DO (mg/l) | B0D (mg/l) |
|---|---|---|---|---|---|
| Eastern | Mechi | 8.3 | 30 | 8.9 | 1.8 |
| | Kankai | 7.7 | 60 | 8.7 | 2 |
| | Arun | 6.5 | 200 | 9.1 | 2.1 |
| Central | East Rapti at Sauraha | 7.8 | 213 | 8.7 | 2.5 |
| Western | Seti at Ramghat | 8.2 | 222 | 9.3 | 2 |

[70] http://id.loc.gov/authorities/subjects/sh2004003301.html. Accessed 1 Jan 2017
[71] Department of Hydrology and Meteorology,1998. CBS: A Compendium on Environment Statistics, Nepal, 1998.
[72] Department of Hydrology and Meteorology,1998. CBS: A Compendium on Environment Statistics, Nepal, 1998

Table 14. Water Quality of Major Rivers During the Dry Season

| Development Region | Location / River | pH | TDS (mg/l) | DO (mg/l) | B0D (mg/l) |
|---|---|---|---|---|---|
| Mid- Western | Bheri at Chatagaon | 7.8 | 208 | 9.3 | 1.1 |
| Far -Western | Karnali at Chisapani | 8.9 | 264 | 10.5 | 1.5 |
| | Mahakali at Pancheswor | 8.8 | 110 | 5 | 2 |
| | **WHO Guideline** | **6.5-8.5** | **100** | **>5.0** | **3** |

Source: Department of Hydrology and Meteorology, 1998

Table 15. Ground Water Quality of (Shallow Tube) Aquifers in the East Tarai, 2003

| Site (District) | Chloride (mg/l) | Ammonia (mg/l) | Nitrate (mg/l) | Iron (mg/l) | Manganese (mg/l) | Coliform (cfu/100 ml) |
|---|---|---|---|---|---|---|
| Panchgachhi (Jhapa) | 15.4 | 0.7 | 0.2 | 6 | 0.8 | 1.1 |
| Baijanathpur (Morang ) | 16.6 | 0.5 | 0.2 | 4.5 | 0.5 | 15.9 |
| Bayarban ( Morang ) | 17.6 | 0.5 | 2.4 | 6 | 0.6 | 0.5 |
| Takuwa ( Morang ) | 21 | 1 | 1 | 10.4 | 0.4 | 45.9 |
| Shreepur Jabdi (Sunsari) | 37.2 | 0.9 | 0.2 | 8 | 0.6 | 25.5 |
| Bandipur (Sunsari) | 195.6 | 0.7 | 3.5 | 0.4 | 0.4 | 1 |
| Naktiraipur (Saptari) | 45.6 | 1.2 | 0.3 | 12 | 1.3 | 16 |
| **WHO Guideline** | **250** | **1.24** | **10** | **3** | **0.5** | **Nil** |

Source: Environment and Public Health Organization 1999 and United Nations Environment Program, 2000.

Drinking water

Nepal is a mountainous country with diverse physiographic regions, and thus different sources of drinking water are available for people in different areas. Tap water is the most important source, providing drinking water to almost 53% of all households. Tap water refers to water piped directly from a source as well as to centrally distributed and pre-treated water. The second most important source is tube wells. These two sources are important in both urban and rural areas. The relative share of tap water in urban and rural areas is 65% and 51%, respectively, followed by tube wells with 23% and 29%. While tap water is the dominant source in the Mountains and Hills, tube wells dominate in the Tarai.[73]

Table 16. Mineral Contaminants of Drinking Water, 2009/10

| Parameters | Unit | Maximum | Minimum | Mean |
|---|---|---|---|---|
| pH(25ºC) | - | 9.8 | 4.0 | 6.9 |
| Total dissolved solid (25ºC) | ppm | 544.1 | 9.99 | 44.23 |
| Ammonia (Qlt- test) | - | +ve | Abs | - |
| Sulphate (Qlt- test) | - | - | - | - |

[73] Environment Assessment of Nepal: Emerging Issues and Challenges. http://www.preventionweb.net/publications/view/2728, Accessed 8 Nov 2016

Table 16. Mineral Contaminants of Drinking Water, 2009/10

| Parameters | Unit | Maximum | Minimum | Mean |
|---|---|---|---|---|
| Hardness as CaCO3 | ppm | 84.0 | 6.0 | 32.84 |
| Alkalinity as HCO3 | ppm | 213.5 | 24.4 | 41.23 |
| Iron | ppm | 1.96 | ND | 0.018 |
| Chloride | ppm | 32.0 | 6.0 | 17.1 |
| Calcium | ppm | ND | - | - |
| Magnesium | ppm | - | - | - |
| Zinc (mg/l) | ppb | - | - | - |
| Lead (mg/l) | ppb | - | - | - |
| Cadmium | ppb | | | |
| Arsenic | ppb | ND | ND | ND |

ND: Not defined, ppb: parts per billion, ppm: parts per million, Qlt=Qualitative test

Source: Department of Food Technology and Quality Control -2009/10.

Table 17. Bacteriological Water Quality of Different Water Sources, Kathmandu Valley

| Fecal Coliform/ 100 ml | Value as % of Sample Units (n =16) | | | | | | | | WHO Guideline Value |
|---|---|---|---|---|---|---|---|---|---|
| | Dug Well | Tube well | Deep Well | Spring | Stone Spout | Pond | River | Pipe Water | |
| 0 | 0 | 60 | 80 | 40 | 20 | 0 | 0 | 60 | 0 |
| 1–100 | 40 | 30 | 15 | 30 | 40 | 0 | 0 | 20 | |
| 101–1,000 | 30 | 5 | 5 | 30 | 40 | 0 | 100 | 20 | |
| >1,000 | 30 | 5 | 0 | 0 | 0 | 100 | >0 | 0 | |

ml = milliliter, n = number, WHO = World Health Organization

Source: Environment Assessment of Nepal: Emerging Issues and Challenges. http://www.preventionweb.net/publications/view/2728, Accessed 8 Nov 2016

### 4.1.7 Air Quality

Ambient air pollution may derive from both natural and anthropogenic sources. Anthropogenic activities have been largely responsible for changing the air quality in urban areas in Nepal as elsewhere. The major sources of such pollution in Nepal are vehicle and industrial emissions, and combustion of biomass and fossil fuels. Anthropogenic activities have added large amounts of macro and micro-pollutants to the atmosphere, triggering an environmental problem.

Many studies over the last decade have shown that ambient air in the Kathmandu Valley is heavily polluted and not in accordance with international standards, and that the air quality is

deteriorating.[74] This development has mainly been due to a rapid rise in the number of petrol and diesel vehicles plying the streets. At the same time, continued emissions from the many brick kilns, the dyeing industry, and other industries are also important contributors.

The main pollutants measured for monitoring air quality are total suspended particles (TSP) and particulate matter of 10 micrometers (µm) or less in diameter (PM10). Currently, PM2.5 (at some stations only), nitrogen dioxide ($NO_2$), and benzene are also monitored on a regular basis. Analysis of the monitoring results indicates that the major problem is a high level of suspended particulate matter together with increasing levels of $NO_2$ and sulfur dioxide ($SO_2$).[75]

Particulate matter is a serious problem in Kathmandu Valley. From a diesel vehicle's black puff of smoke to the haze that obscures the view of the beautiful Himalayas, particle pollution affects all residents.

Air quality monitoring results for major cities are presented in Table 18.

**T**able 18. Air Quality Monitoring Results for Major Cities ($PM_{10}$, TSP, $SO_2$, $NO_2$, Co and Pb)

| Major city (Site) | Altitude (masl) | Date | Time | Parameters | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | PM10 | TSP | $NO_2$ | CO | Pb |
| | | | | (µg/m$^3$) | (µg/m$^3$) | (µg/m$^3$) | (µg/m$^3$) | (µg/m$^3$) |
| Pokhara | 827 | 26/11/2000 | 10:00-18:00 | 90.2 | 118.5 | 9.1 | NA | 0.11 |
| Birganj | 91 | 30/11/2000 | 10:00-18:00 | 482.9 | 567.8 | 23 | 378 | 0.27 |
| Biratnagar | 125 | 4/12/2000 | 08:00-16:00 | 961.4 | 1024.3 | 24.5 | 1145.5 | 0.24 |
| Janakpur | 90 | 7/11/2000 | 11:00-19:00 | 1820.9 | 2019.5 | 20.7 | 859.11 | 0.53 |
| Narayanghat | 256 | 10/12/2000 | 08:00-16:00 | 196.3 | 260.3 | 14.8 | NA | 0.04 |
| Butawal | 205 | 19/12/2000 | 07:00-15:00 | 1076.6 | 1150.2 | 21.38 | 229.09 | 0.09 |
| Bhairahawa | 110 | 22/12/2000 | 07:00-15:00 | 864.8 | 926.41 | 23.28 | 1145.5 | 0.13 |
| Nepalganj | 144 | 26/12/2000 | 07:00-15:00 | 2104.8 | 2222.5 | 17.78 | 1445.5 | 0.23 |
| Mahendranagar | 176 | 29/12/2000 | 08:00-16:00 | 355.05 | 378.54 | 17.14 | NA | 0.04 |
| **Nepal standards** | | | | **120** | **230** | **40** | **10,000** | **0.5** |

Note: Data were collected using high volume air sampler. (Averaging Time 8 hrs.)
Source: Nepal Health Research Council and Nepal Environmental and Scientific Services (P) Ltd., (Transport Sector Air Pollution Survey, at Nine Major Urban Cities of Nepal, the World Conservation Union, Sept, 2001).

[74] Environment Assessment of Nepal: Emerging Issues and Challenges. http://www.preventionweb.net/publications/view/2728, Accessed 8 Nov 2016
[75] Ibid.

The use of biomass fuels such as wood, dung, agricultural waste, and charcoal as cooking and heating fuel is the principal cause of indoor air pollution in the rural areas of Nepal. Poverty is one of the main barriers to the adoption of cleaner fuels, and the slow pace of development implies that biofuels will continue to be used by the poor. Limited ventilation increases exposure in poor households, particularly for women and young children as they spend long periods of time indoors. The smoke from biomass fuels is a complex mixture of aerosols containing significant amounts of carbon monoxide (CO), suspended particulate matter, hydrocarbons, and NOx. Exposure to indoor air pollution carries severe health threats. Exposure to the smoke from a single day's cooking is approximately equivalent to smoking two packets of cigarettes,[76] directly affecting lungs and chest and posing risks for chronic respiratory disorders, acute respiratory infections (ARI), including pneumonia and bronchitis, chronic obstructive pulmonary disease, lung cancer, and other problems.[77]

### 4.1.8 Noise

Noise is becoming a significant form of pollution in urban areas of Nepal. It is a public nuisance and affects people's health physically and psychologically, by increasing irritation, tension, nervousness, and anxiety. Transport noise, industrial noise, and community or neighborhood noise represent the leading forms of noise pollution in Nepal.[78] Prolonged exposure to high noise levels may cause permanent hearing loss. Industrial noise is also a significant occupational hazard. Many noise-sensitive sites such as schools and hospitals are also subject to much higher levels of noise than acceptable.

Similar to air pollution, noise is on the increase in municipal and industrial areas. Sources of significant noise include traffic, industries, use of heavy machines and tools in construction and commercial activities, and use of loudspeakers. Conflicting land use in urban areas has contributed to noise pollution where residential use is mixed with noise-causing industries. Transportation is one of the predominant sources of noise pollution. Power tillers, buses, heavy trucks, and three-wheelers are significant contributors to noise pollution in municipal areas.[79]

Road traffic noise levels in Kathmandu range from 70 to 100 dBA. The noise level in industries such as textile, metal works, cement, and flour mills is very high, with noise levels exceeding 90 dBA.[80] People living around airports are subject to high levels of noise produced by aircraft.

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[76] International Centre for Integrated Mountain Development & Asian Development Bank.2006. Environment Assessment of Nepal Emerging Issues and Challenges

[77] Ibid.

[78] International Centre for Integrated Mountain Development & Asian Development Bank. 2006. Environment Assessment of Nepal Emerging Issues and Challenges

[79] Ibid.

[80] Ibid.

Noise level measurements in different areas of Kathmandu are presented in Table 19.

Table 19. Noise Level in Different Areas of Kathmandu

| Traffic Area | Day Hours/dBA | | | Night Hours/dBA | |
|---|---|---|---|---|---|
| | Nepal Observed | WHO Guideline | Indian Guideline | Nepal Observed | Indian Guideline |
| **High Traffic Area** | | 70 | | | |
| Kalanki, Kathmandu | 74 | | | 70 | |
| Shahidgate, Kathmandu | 67 | | | 69 | |
| Putalisadak, Kathmandu | 75 | | | 69 | |
| Maitighar, Kathmandu | 71 | | | 70 | |
| TU Gate, Kirtipur, Kathmandu | 58 | | | 58 | |
| Lagankhel, Lalitpur | 70 | | | 70 | |
| Satdobato, Lalitput | 70 | | | 71 | |
| Kupandol, Lalitpur | 77 | | | 75 | |
| Suryabinayak, Bhaktapur | 71 | | | 81 | |
| Thimi Bus Stop, Bhaktapur | 65 | | | 53 | |
| Ramananda Chowk, Janakpur | 68 | | | 62 | |
| **Commercial Cum Residence Area** | | | 64 | | 55 |
| Asan Chowk, Kathmandu | 74 | | | 67 | |
| Naya Bazar, Kirtipu, Kathmandu | 64 | | | 62 | |
| Manbhawan, Lalitpur | 71 | | | 67 | |
| Bhanu Chowk, Janakpur | 70 | | | 67 | |
| **Commercial Cum Tourist Area** | | | 65 | | 55 |
| Thamel Chowk, Kathmandu | 75 | | | 61 | |
| Darbar Squar, Bhaktapur | 59 | | | 50 | |
| Mangal Bazar, Lalitpur | 69 | | | 59 | |
| Janaki Mandir, Janakpur | 73 | | | 70 | |
| **Old Residence Area** | | | | | 45 |
| Lagan, Kathmandu | 68 | | | 67 | |
| Panga, Kirtipur, Kathmandu | 60 | | | 57 | |
| Bhatkepati, Kirtipur, Kathmandu | 52 | | | 60 | |
| Pimbhal, Lalitpur | 57 | | | 51 | |
| Katunje, Bhaktapur | 52 | | | 65 | |
| Bhairab Mandir, Bhaktapur | 67 | | | 51 | |
| Maharaj Sagar, Janakpur | 58 | | | 61 | |
| **New Residence Area** | | | 55 | | 45 |
| Samakhushi, Kathmandu | 55 | | | 60 | |

Table 19. Noise Level in Different Areas of Kathmandu

| Traffic Area | Day Hours/dBA | | | Night Hours/dBA | |
|---|---|---|---|---|---|
| | Nepal Observed | WHO Guideline | Indian Guideline | Nepal Observed | Indian Guideline |
| Sano Thimi, Bhaktapur | 62 | | | 62 | |
| Sanitar, Bhaktapur | 60 | | | 53 | |
| Sainbu, Lalitpur | 45 | | | 42 | |
| Khumaltar, Lalitpur | 53 | | | 54 | |
| **Industrial Area** | | 70 | 75 | | 70 |
| Balaju Yantra Shala, BID | 78 | | | 70 | |
| Chirag Foam Ind. Pvt. Ltd., BID | 63 | | | 54 | |
| Balaju Industrial Gate, BID | 74 | | | 68 | |
| Supreme Textile, PID | 61 | | | 58 | |
| Himal Tents Pvt. Ltd., PID | 61 | | | 56 | |
| Patan Industrial Gate, PID | 70 | | | 70 | |

Source: Nepal Health Research Council and World Health Organization, Assessment of Noise Pollution and Development of Criteria for its Prevention and Control, June 2003.

## ECOLOGICAL RESOURCES

### 4.1.9 Ecological Zones

Researchers have developed several ecological boundaries for various purposes. A three–zone system based mainly on the three main river systems (Karnali, Gandaki and Koshi) has been developed by the Department of Forest Research and Survey:

a. Mountains.
b. Hills.
c. Tarai

The three zones are depicted in Figure 18.


Figure 18. Ecological Zones of Nepal
Source: http://un.org.np/sites/default/files/report/tid_188/NatBio00002.jpg. Accessed 16 Nov 2016

**Bio-climatic zones**

As per Ministry of Forest and Soil Conservation classifications, Nepal has six bioclimatic zones; though other classifications have 11 zones which include altitudinal subdivisions. Table 20 presents bioclimatic zones and Table 21 shows a profile of these bio-climatic zones in respect to their elevation and physiographic zones.

Table 20. Physiographic and Bioclimatic Zones of Nepal

| Physiographic Zone | Area (%) | Elevation (masl) | Bioclimatic Zone |
|---|---|---|---|
| High Himal | 23 | above 5000 | Nival (Tundra and Arctic) |
| High Mountains | 19 | 4,000-5,000 | Alpine |
| | | 3,000-4,000 | Sub-alpine |
| Middle Mountains | 29 | 2,000-3,000 | Montane(Temperate) |
| | | 1,000-2,000 | Subtropical |
| Siwalik | 15 | 500-1,000 | Tropical |
| Tarai | 14 | below 500 | Tropical |

Source: Ministry of Forest and Soil Conservation

Table 21. Profile of Bioclimatic Zone Sub Divisions

| Vegetation (Bio-climatic) Zone | Altitude in (masl) | Physiographic Zone |
|---|---|---|
| Tropical Lower | Below 500 m | Tarai |
| Upper | 500 to 1 000 m | Siwalik |
| Sub-tropical Lower | 1 000 to 1 500 m | Middle Hills |
| Upper | 1 500 to 2 000 m | |
| Temperate Lower | 2 000 to 2 500 m | |
| Upper | 2 500 to 3 000 m | |
| Sub-Alpine Lower | 3 000 to 3 500 m | High Mountain |
| Upper | 3 500 to 4 000 m | |
| Alpine Lower | 4 000 to 4 500 m | |
| Upper | 4 500 to 5 000 m | |
| Nival | Above 5 000 m | High Himalayas |

### 4.1.10 Protected Areas

Nepal is a landlocked country rich in both natural and cultural diversity. The range of altitudes from the lowland plains of the Tarai to the high peaks of the Himalaya has produced an unparalleled diversity of habitats from tropical forests in the south to alpine grasslands in the north, supporting a large variety of flora and fauna.

In Nepal, many people live in areas immediately adjacent to protected areas and in some cases, within the buffer zones of protected areas. Crops and farming practices of the communities have been

modified according to altitude, climate and soils, and the use of natural resources changes in relation to variations in local ecology and the prevailing socio-economic conditions. Traditionally, most people have depended on a combination of farming and products from the natural environment for most of their basic living requirements and this is still the case in almost all of the rural parts of the country even today. This has presented many challenges since there is rarely a clear separation of the activities and requirements of humans and wildlife. Wildlife can be pests of crops and in some cases a direct threat to humans. Likewise, humans can be a threat to wild animals and plants through poaching, attempted pest control, overharvesting, habitat destruction, pollution, overgrazing and disturbance. There are many opportunities for animal and plant species, particularly exotics that are harmful to natural systems, to cross from cultivated land into natural areas. On the other side of the coin natural areas can offer incomes through nature-based tourism.

Tourism, which is mostly nature-based, is one of Nepal's major sources of income. Most tourists visit the county's national parks and other protected areas as well as enjoying the great wealth of cultural richness. Thus, there is a clear interdependence of humans and natural resources in Nepal and the livelihood of the great majority of the population at local and national levels depends on how successfully this interdependence is managed.

Protected areas are also often the only remaining sources of many natural products, such as building materials, firewood and medicinal plants, upon which local people depend. Nepal has had some 40 years of intensive research and practical experience of protected area management and approaches to achieve compatibility between the needs of conservation and local communities. This has resulted in the many successful case histories for the conservation of threatened species within protected areas such as the Tiger, Indian Rhinoceros, and the fish-eating Gharial, and development of general models for successful management of forested areas.

The number and the extent of protected areas are continually increasing. There are currently 17 protected areas (8 national parks, 4 conservation areas, 4 wildlife reserves, and a hunting reserve) covering about 16.6% of the total surface area of the country. The area of protected areas may even exceed 25% with the inclusion of existing and proposed buffer zones.[81] A brief description[82] of protected areas is given below and the locations of the protected areas are shown on Figure 19.

**Sagarmatha National Park**

The Sagarmatha National Park was established in 1976 and covers an area of 1,148 km$^2$ in the Himalayan ecological zone. Since 1979, it has been an UNESCO World Heritage Site. Mount Everest (Sagarmatha), at 8,848 masl, is the crowning glory of the park and other famous peaks in the park that are above 6,000 masl include Lhotse, Cho-Oyu, Thamserku, Nuptse, Amadablam and Pumori. The park has many glaciers, some of them 2 to 3 km long and can be seen at the head of the Khumbu Valley.

[81] FAO. 2000. FRA.2000 - Forest Resources of Nepal, Country report

[82] Ibid

The tree line is at about 4,500 masl. Forested areas above 3,500 m are dominated by silver fir, birch, rhododendron and junipers. Below 3,500 masl the forest mainly comprises pine and hemlock. While Himalayan thar and musk deer are the main large mammals, Himalayan black bear, common langur, jackal, marten and Himalayan mouse hare are also seen in the park. More than 118 species of birds have been identified in the park, including common ones like blood pheasant, red-billed chough and yellow-billed chough.

About 3,500 Sherpa reside within the park. The traditional economy of the Sherpa community depends on agriculture, livestock and trade with Tibet but is becoming increasingly dependent on tourism.

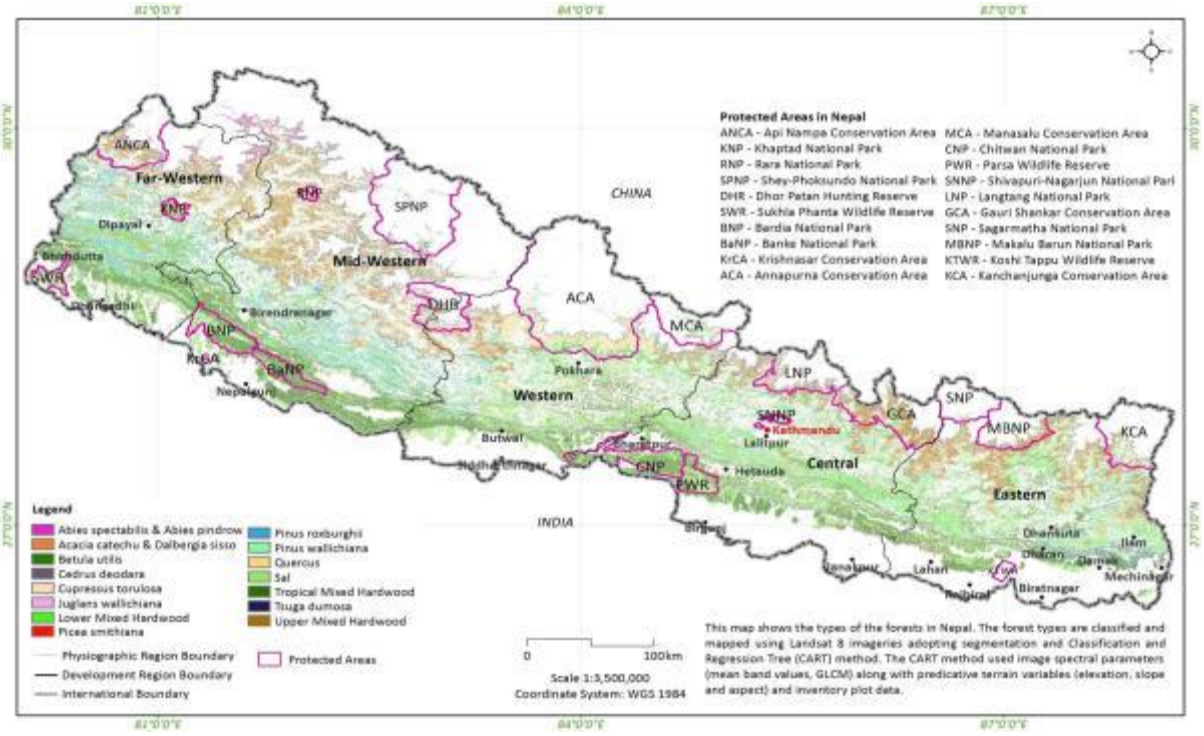



**Figure 19. Protected Areas with Forest Types of Nepal**
Source: DFRS, 2014

**Langtang National Park**

Langtang National Park extends over an area of about 1,710 km$^2$ and was established in 1976. It falls within the high Himalaya and high mountain geo-physiographic zones. There are several peaks with elevations of more than 6,500 masl, including Langtang, Lirung, Dorijee Lagpa and Phubichya.
The park broadly supports six forest types: chir pine forest; oak forest; fir, spruce, deodar and blue pine forest; moist mixed temperate forest; sub-alpine forest; and moist alpine forest. The flora mainly consists of oaks, chir pine, maple, fir, blue pine, hemlock, spruce and rhododendron. The park provides

habitat for wild dog, red panda, pika, muntjac, musk deer, Himalayan black bear, Himalayan thar, ghoral, serow, rhesus monkey and common langur.

**Royal Chitwan National Park**

Royal Chitwan National Park, the oldest national park in Nepal, was established in 1973 and extends over about 932 $km^2$. Prior to the 1950s it was a royal hunting reserve. The first conservation efforts in the area date back to 1962 when a part of this park was declared a rhino sanctuary. The park lies in a valley formed by Siwalik hills and the lower Himalayas. Three rivers (the Narayani, Reu and Rapti) flow through the park and provide marshes and swamps for rhino and elephant.

The park contains dense tropical moist deciduous forests of three subtypes. The first is a narrow belt of pine forest on the tops of the Siwalik ridges; the second riverine forests and grasslands in the flood plains of the rivers; and the third sal forests, covering about three quarter of the park. The park supports a wide variety of birds and animals. It is famous as the western-most habitat of single-horned rhinoceros. The park supports elephant, deer, tiger, leopard, boar, langur, monkey, wild dog, hyena, spotted linglang and ratel. Many local and migratory birds such as peafowl, open bill stork, pied kingfisher, golden-backed woodpecker, black-headed oriole, giant hornbill, black-necked stork can be easily observed in the park.

**Shey-Phoksundo National Park**

Shey-Phoksundo National Park was established in 1984 with an area of 3,555 $km^2$. The park falls in the high Himalayan geo-physiographic zone. It supports a variety of tree species including blue pine, spruce, cypress, poplar, deodar, fir, birch, and oaks. The main fauna includes snow leopard, blue sheep, ghoral, Himalayan thar, serow, wolf, leopard, jackal, Himalayan black bear, Himalayan mouse hare, Himalayan weasel, yellow throated marten, langur and rhesus monkeys.

**Rara National Park**

This is a small park covering about 106 $km^2$ and lies mostly in the Mugu district north-west of Kathmandu. A small part of the park falls in the Jumla district. The Rara Lake and River, covering an area of 10 $km^2$, are the unique features of this park. The highest peak in the park is Chuchemara with an elevation of 4,000 masl.

The forest mainly consists of blue pine, chir pine, deodar, fir, spruce, oak and rhododendron species. The park supports a wide variety of animals including leopard, black bear, musk deer, goral, serow, bharel and wolf. The bird species include snow cock, pheasants, monal and chukor. Snow trout is the only fish species recorded in the lake.

**Royal Bardia National Park**

The Royal Bardia National Park was developed as a national park in 1988. The park is one of the largest (968 $km^2$) park with best wilderness areas in Nepal. It is situated along the Karnali River in the mid-west Tarai region toward the southern side of the Churia Hills.

The park supports sal forests, riverine forests, grasslands, swamps and marshes. About 70% of the park consists of sal forests and the remaining 30% supports riverine grassland, open phanta, semal savannah, harwood and khair-sisoo forests. The park provides habitat for tiger, leopard, elephant, wild buffalo, swamp deer, spotted dear, sambhar and wild boar. Major aquatic species include Gangetic dolphin, gharial, crocodile, otter and mahaser fish. More than 35 species of mammals, over 260 species of birds, 60 species of fish and 25 species of reptiles have already been identified in the in the park.

**Makalu Barun National Park**

The Makalu Barun National Park has an area of 1,500 $km^2$ and belongs to the high Himalayan and high mountain geo-physiographic zone. It was established in 1992 and derives its name from Mt. Makalu (8,463 masl) and the Barun River. Other major rivers flowing through the park include the Saldimas, Kasuwa, Isuwa, Apsuwa, Sanhuwa, Hongu and Inkhu. The park falls in tropical to Nival bio-climatic zones.

The vegetation of the park consists of such species as rhododendron, juniper, fir, birch, oak, chestnut, pine, aromatic herbs and wildflowers. The park supports a large variety of fauna including clouded leopard, forest leopard, jungle cat, grey wolf, Himalayan black bear, red panda, musk deer, barking deer, wild goat, and wild boars. About 440 bird species, 30 reptile species, and 15 amphibian species have been identified in the park.

**Khaptad National Park**

The Khaptad National Park covers an area of 225 $km^2$ and was established in 1986. It is in the far western development region and the middle mountain physiographic zone. The park is located where the borders of the Bajura, Doti and Achhlam Districts meet.

The vegetation types range from sub-tropical forests at the lower altitudes to temperate grasslands intermixed with oak and coniferous forests on the Khaptad Plateau. Common species are chir pine, spruce, fir, maple, birch, alder, rhododendron and bamboo. The park supports fauna such as leopard, Himalayan yellow throated marten, black bear, wild dog, wild boar, jackal, musk deer, ghoral, wolf and langur. The common bird species include impeyan pheasant, chukor partridge, kalij pheasant and monal.

**Shivapuri and Nagarjun National Park**

The Shivapuri Watershed and Wildlife Reserve was created in 1985 with an area of 97 $km^2$ and later designated as the Shivapuri and Nagarjun National Park. The area falls in the Middle Mountain physiographic zone. The vegetation includes pine, chestnut and rhododendron. Himalayan bear, leopard, deer, wild boar and langur are the main wild animals reported in the park.

**Makalu Barun Conservation Area**

The Makalu Barun Conservation Area was established as a conservation area in 1993 and serves as a buffer zone to Makalu Baraun National Park. It is spread over an area of 830 $km^2$. Being a buffer zone, the area supports a human population of about 32,000 representing Rais, Sherpas and Shingsawas

(Bhotes) tribes who are mostly dependent on agriculture, forests, animal husbandry and seasonal migratory labor jobs.

**Kanchenjunga Conservation Area**

The Kanchenjunga Conservation Area was established in 1997 over an area of 2 035 $km^2$. It contains a part of the second highest mountain, Kanchenjunga, in the world. Nepal, India and Tibet share Kanchenjunga. In India, it is protected though Kangchendzonga National Park and in Tibet by Qomolongma Nature preserve.

**Annapurna Conservation Area**

The Annapurna Conservation Area Project, a globally recognized conservation initiative, was developed and managed by the King Mahendra Trust for Nature Conservation. The area has evolved from an integrated conservation development project in 1986 to the status of a protected area in 1992 and has an area of 7,629 $km^2$. The ACA contains many villages that are organized into fifty-five village development committees and falls within the districts of Kaski, Myagdi, Lamjung, Manang and Mustang.

**Manaslu Conservation Area**

The Manaslu Conservation Area, covering 1,663 $km^2$ was established in 1998. The area is located in north Gorkha district and encompasses seven village development committees (Samagaun, Lho, Prok, Bihi, Chunchet, Chhekampar and Sirdibas). It derives its name after the Manaslu (8 163 m) Peak. The area is a broadening valley with stony fields and forests.

The area has isolated yak pastures and sparse vegetation toward the peaks and extensive pine and rhododendron forest in the lower valley. The King Mahendra Trust for Nature Conservation has been granted the management of area till the year 2008. It has over 6 000 inhabitants whose main occupation is agriculture and animal husbandry.

**Koshi Tappu Wildlife Reserve**

The Koshi Tappu Wildlife Reserve was established in 1976, covering 175 $km^2$ of the Koshi flood plain lying in the Saptari, Udyapur and Sunsari Districts (CBDC, 1998). Since 1987 it has been classified as a wetland of international importance under the Ramsar Wetland Convention. The vegetation is mainly khar-patter grassland with patches of khair-sisoo forest.

The reserve is the only area in Nepal that has wild buffalo, numbering about 100. It also supports tigers and ungulates and provides habitat to about 295 bird species. The swamp partridge and Bengal florican are significant endangered species in the reserve.

**Royal Suklaphanta Wildlife Reserve**

The Royal Suklaphanta Wildlife Reserve is in the riverine plain of the Mahakali River and extends over an area of 305 ha. The vegetation comprises open grasslands intermixed with forests and swamps locally known as "phanta." The reserve is famous mainly for the habitat of the swamp deer. It also supports

other animals including tiger, leopard, deer, elephant, wild boar, gharial and crocodile. Many local and migratory birds can also be observed here.

**Parsa Wildlife Reserve**

The Parsa Wildlife Reserve was established in 1976 with an area of 175 km$^2$ in the Chure Bhavar Region and mostly supports sal forests. The reserve also contains a human settlement (Rambhori Bhata) that is reported to adversely affect the wildlife in the reserve. The reserve is contiguous to the Royal Chitwan National Park in the west and extends almost to the Hetauda-Birjung highway in the east. The flora and fauna of the reserve is mostly similar to the Royal Chitwan National Park.

The reserve supports wild elephants, tigers, leopards, sloth bears, gaurs, blue bulls and wild dogs. Rhinoceros can be observed on the flood plain of Rapti River. The Halkhoria marshy lakes in the east function as a corridor for elephants and rhinos. The Kalopani marshy area provides water to many ungulates and carnivores. More than 300 species of bird species have been recorded in the park.

**Dhorpatan Hunting Reserve**

The Dhorpatan Hunting Reserve extends over an area of 1 325 km$^2$ and was established in 1987. The main plant species include fir, spruce, juniper, birch, oak, pine, rhododendron and hemlock. The main fauna of the hunting reserve consists of leopard, ghoral, tahr, black bear, barking deer, blue sheep, wild boar, mouse hare and langur[83].

### 4.1.11 Nepal's overall biodiversity resources and its global significance including current status of habitats (modified, natural, critical) and threats.

**Overall biodiversity**

The concentration of diverse natural resources and environments of Nepal within an area of approximately 150 by 250 kilometers (roughly 100 by 150 miles) is due to the extremes of altitude reached over and over again by the seemingly endless stretches of hills, mountains and incised deep valleys within its small area, which also includes a swath of flatland (the "Tarai") stretching from the Ganges River of India into Nepal's southern borderlands.

This diverse topography accounts for the fact that more than two per cent of all flowering plants, eight percent of all birds, and four percent of all mammals flourish here. Many species have religious value and are sources of food, fuel, fiber, dyes, oil, gums and medicine.[84] Except for oceans and hot deserts, most of the world's ecosystems are found in Nepal. There are 75 types of vegetation and 35 types of forests, some maps of which are found elsewhere in this PESIA report. Many animals and plants are unique to Nepal. There are 832 species of birds of Nepal, and 1,253 species of vertebrates. More than 100 of these species are in some kind of threatened status.[85]

[83] FAO. 2000. FRA.2000 - Forest Resources of Nepal, Country report
[84] http://www.icem.com.au/documents/biodiversity/bioplan/nepal.pdf
[85] http://asciencep.blogspot.com/2010/05/biodiversity-in-nepal.html

**Status of habitats**

Nepal has reserved nearly one fifth of its area for natural parks, conservation areas, wildlife reserves, bird conservation and hunting zones.[86] However, there are major areas of threat. Forest cover in the Tarai and Hill areas is reported to have decreased from 1-2 percent annually in recent decades. About half of Nepal's population of more than 23 million live in the Tarai, while the other half are in Kathmandu, the hills and the mountains.

The economic wellbeing of Nepal is closely bound to its natural resources – agricultural land, wetlands, forests, and protected areas. Nepal ranks 138th out of 177 countries in the 2006 Human Development Index, and 68th among 102 developing countries in the Human Poverty Index. Although only 20 percent of land area is agricultural, agriculture is the major determinant of economic activities and the nation's socio-political identity as well as the primary factor impinging on the natural environment at present. Forests cover some 29 percent of the land area. The high demand for agricultural land has led to considerable deforestation and loss of land cover. Natural phenomena such as floods and landslides contribute to an annual soil loss of 20-25 tons/ha. The majority of protected areas including the major national parks comprise forested land. Nepal's bio-resources in the international trade are mostly wild in origin: various plant parts such as roots and tubers (39 plants), barks (seven plants), leaves (26 plants), flowers (14 plants), fruits and seeds (61 plants), whole plants (12 plants), gums and resins (eight plants), and miscellaneous other plants (11). Tourism is the second most important source of foreign exchange for Nepal.[87] Tourism, including birding, especially along Nepal's several major international flyways is one of the areas also subject to impacts from threats to Nepal's biodiversity.

**Conservation of Biodiversity**

Biodiversity is ingrained in the culture of Nepal. Various legislations such as The National Park and Wild Life Conservation Act (NPWCA) of 1973 and the network of Protected Areas provide institutional support to biodiversity conservation in Nepal. All protected areas have management plans and clearly delineate their core and buffer areas. The management of buffer zones is more people-centered and community-based than that of the core areas. Two of the eight national parks (Royal Chitwan and Sagarmatha National Parks) are World Heritage sites. The Koshi Tappu Wildlife Reserve has wetlands of international importance, especially for migratory waterfowl, and is listed under the Ramsar Convention. It is noteworthy that Protected Areas alone contain 191 endemic species.

However, anthropogenic disturbance has led to inclusion of 61 species on the list of threatened species for Nepal.[88]

**Threats to Biodiversity**

Loss and fragmentation of suitable natural habitat, high grazing pressure and poaching are the main threats to biodiversity conservation in Nepal. Fragmentation of habitats has limited the dispersal and

[86] *Ibid.*

[87] http://lib.icimod.org/record/7560/files/Nepal%20Biodiversity%20Resource%20Book.pdf

[88] Charles Sturt University. 2012. Environment and Culture in Nepal: Optimising the needs of Protected Areas, Threatened Species and Human Livelihoods

recolonization of rare species such as tigers. Fragmentation of habitat has also increased the amount of forest edge, increasing predation and competition from exotic and pest species. Many of the national parks and reserves are too small and too isolated to maintain populations of many larger species.

Increased grazing pressure from livestock has largely displaced wild herbivores. Species such as the red panda have been adversely affected by grazing disturbance. Similarly, loss of suitable habitat for the wild water buffalo (*Bubalus bubalis*) has restricted the species to within the 175 $km^2$ of the Koshi Tappu Wildlife Reserve. The pigmy hog (*Sus salvanius*) is believed to have become extinct. The hispid hare (*Caprolagus hispidus*), which has similar habitat requirements to those of the pigmy hog, is also thought to have met the same fate.[89]

The poaching of wildlife, especially endangered species such as tiger, rhino, bear, musk deer, snow leopard, gharial and others is adversely affecting conservation efforts. The control of poaching outside protected areas has proven to be very difficult.

Serious challenges to conservation of the country's biodiversity remain. These include challenges to globally significant wildlife species such as Bengal tiger, greater one-horned rhinoceros, Asian elephant, gharial, Gangetic river dolphin and giant hornbill in the Tarai Arc Landscape (TAL) and snow leopard, red panda and musk deer in the Chitwan-Annapurna Landscape (CHAL). These species require tailored regional conservation strategies in order to ensure their long-term survival. There are also major forest ecosystems in both TAL and CHAL that require protection. TAL supports tall alluvial floodplain grasslands, riverine forest, and khari-sissoo (Dalbergia-Acacia) association in the riverbeds, to mixed hardwood and Sal forests in the drier uplands. CHAL vegetation includes a narrow section of lowland TAL vegetation in the southern proximity, dry deciduous sal forest in the Churia foothills; broadleaf subtropical forests with sal and pine forest in the middle mountain; temperate forest in the high mountain; and birch dominated alpine forest and open rangelands in the high Himalayan region.[90]

According to the WWF Nepal Biodiversity Strategy (2002), the following threats are present:

- Encroachment/fragmentation and degradation of habitat
- Poaching and illegal trade of key wild animals and plants
- Unsustainable use of natural resources
- Spread of invasive alien plant species
- Human-wildlife conflict
- Climate change (direct impacts)
- Overgrazing by livestock
- Fire, flood and landslide

[89] Ibid.
[90] http://www.wwfnepal.org/hariyobanprogram/what_we_do/biodiversity_conservation/

- Pollution of aquatic environments and changes in river flows
- Large infrastructure development[91]

"While the above mentioned are direct threats, there are number of indirect drivers and root causes that interact in complex ways to cause human induced changes in biodiversity. Indirect drivers including inequitable access to forest benefits, lack of economic alternatives, population growth, and cultural and religious factors that influence local communities' behavior in ways that impact biodiversity. And climate change is having increasing impacts on people and nature, in some cases exacerbating indirect drivers of biodiversity loss."[92]

### 4.1.12 Special Conservation Zones

**Chitwan-Annapurna Landscape**

The Chitwan-Annapurna Landscape (CHAL) in Central Nepal is well known for its biodiversity. The landscape is drained by eight major rivers (Kali Gandaki, Seti, Madi, Marsyangdi, Daraundi, Budi Gandaki, Trishuli, Rapti) and their tributaries of the broader Gandaki River system. It encompasses all or part of 19 districts that fall within CHAL, with all or part of six protected areas represented in this landscape (Figure 20). The proposed landscape is 32,068 $km^2$ – 11.4% in the Siwalik, 37.8% in the midhills, and 50.8% in the mountains. CHAL is a portion of a larger landscape, the Greater Himalayan Landscape, conceived in 1999.

The Chitwan-Annapurna Landscape (CHAL) was conceived to maintain north-south ecological connectivity through the range of eco-physiographic zones of the Nepal Himalaya, from Chitwan National Park in the south to Manaslu, Langtang and Mustang in the north. It covers all of the Gandaki river basin in Nepal and includes its confluent rivers, namely: Kali Gandaki, Seti, Marsyangdi, Daraundi, Budhi Gandaki, Trishuli, and Narayani/East Rapti[93]. Altitudinally, the CHAL extends from the tropical lowland Tarai (200m) to alpine high mountains and the cold and dry Trans-Himalayan region (above 4,000 masl), and the high peaks exceed 8,000 masl.

The CHAL has seven protected areas including three national parks (NPs) (Langtang, Chitwan and Shivapuri and Nagarjum), one wildlife reserve (WR) (Parsa), and two conservation areas (CAs) (Annapurna and Manaslu).

The steep and fragile geomorphology of the CHAL makes it vulnerable to natural disasters, and the 2015 earthquakes caused many landslides in the worst affected areas. Climate change is also causing environmental and ecological change, with hazards such as unpredictable and more extreme rainfall

[91] *Ibid.*
[92] *Ibid.*
[93] Ministry of Forests and Soil Conservation. 2015. Strategy and Action Plan 2015-2025. Chitwan-Annapurna Landscape. Nepal

patterns and increasing temperatures, with resulting impacts for local communities, and species range shifts or extinctions.[94]

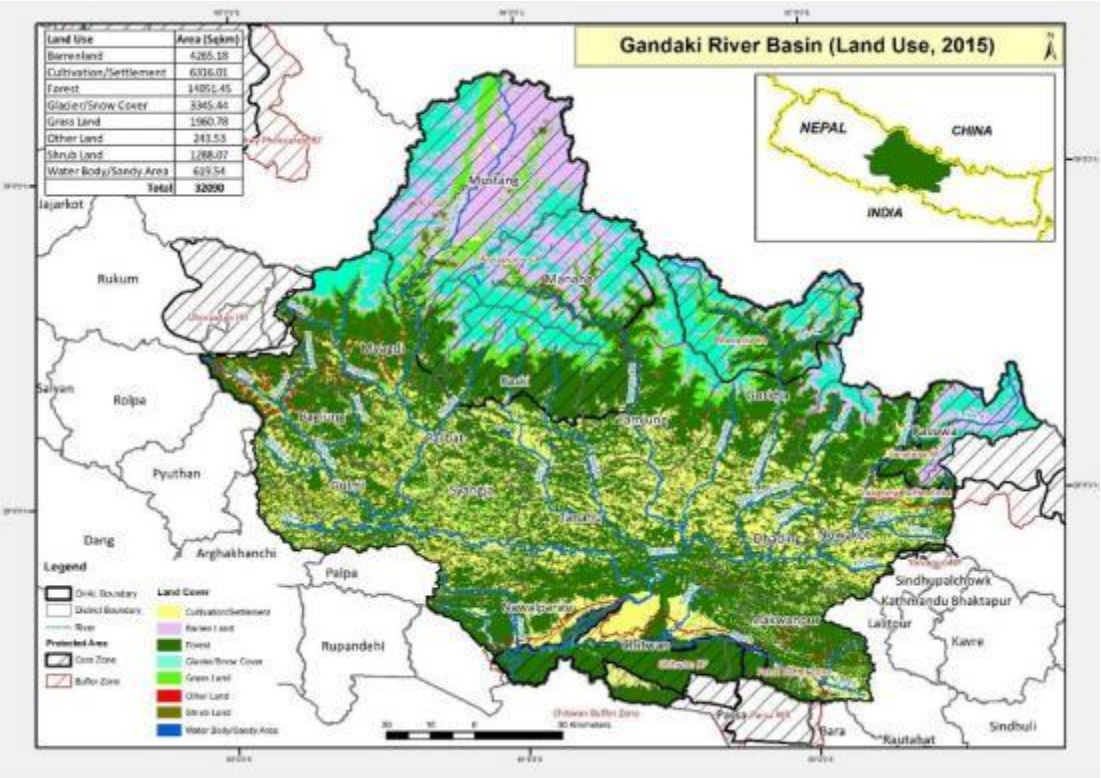



**Figure 20. Location of CHAL in Central-western Nepal**
Source: Ministry of Forests and Soil Conservation, 2015

**Tarai Arc Landscape**

Nepal has been formally protecting its rich biodiversity for more than five decades; however, there was a growing recognition that wide-ranging species such as tiger could not be conserved through protected areas alone. This resulted in a paradigm shift to a landscape-scale approach with creation of the transboundary Tarai Arc Landscape (TAL), and the portion in Nepal was declared a priority conservation landscape by the Government of Nepal (GoN) in 2001.

The entire TAL extends for over 900 km from the Bagmati River, Nepal, in the east, to the Yamuna River in Uttaranchal, India, in the west, with an area of 51,002 km$^2$. TAL-Nepal covers 24,710.13 km$^2$ spread across 18 districts: Dadheldhura, Kanchanpur, Kailali, Bardia, Salyan, Surkhet, Banke, Dang, Arghakhachi, Kapilbastu, Rupendehi, Palpa, Nawalparasi, Chitwan, Makwanpur, Bara, Parsa and Rautahat. Among these districts, Arghakhachi, Palpa, Nawalparasi, Chitwan and Makwanpur overlap with Chitwan

[94] Ministry of Forests and Soil Conservation. 2015. Strategy and Action Plan 2015-2025. Chitwan-Annapurna Landscape. Nepal.

Annapurna Landscape (CHAL)[95]. TAL harbors globally important biodiversity of the Tarai Duar Savanna and Grasslands ecoregion. It adopts a landscape-level approach to conserve several of Asia's large mammals, birds, reptiles, and freshwater fishes; sustain environmental flows that maintain important ecosystems; and provide ecosystem services that support the socio-economic well-being of people and development in the Tarai and Churia region of Nepal.[96]

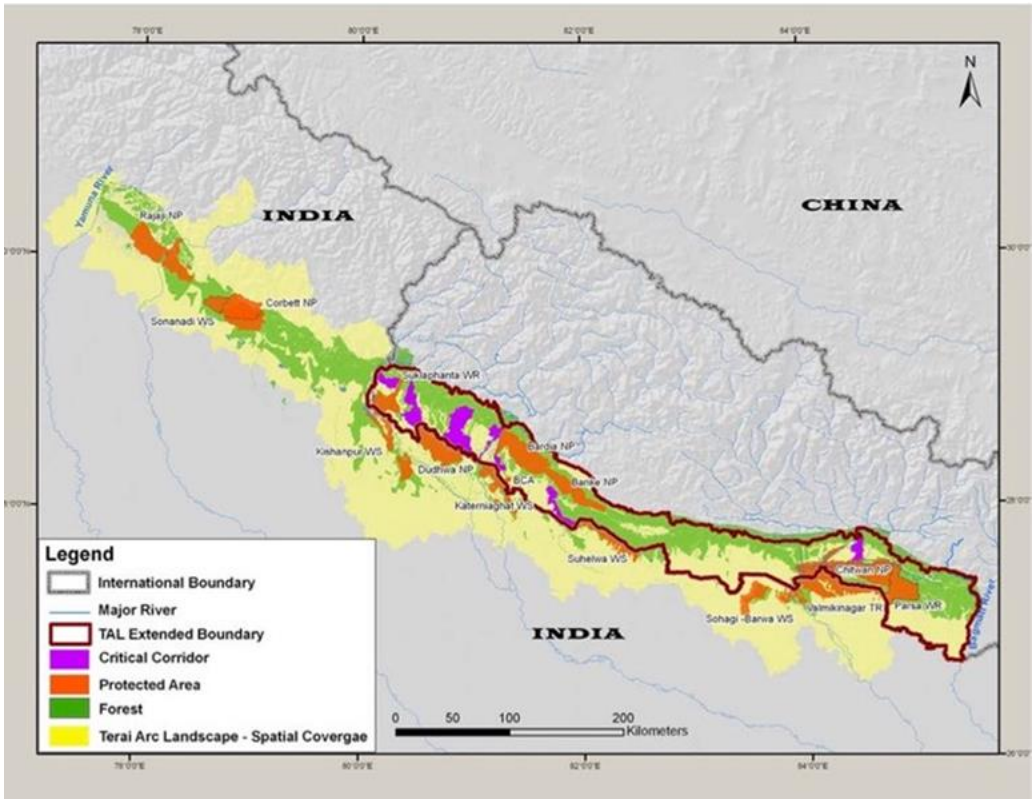



**Figure 21. Chuira Region and the TAL**
Source: Ministry of Forests and Soil Conservation

TAL has six protected areas—three national parks, two wildlife reserves (WRs) and one conservation area—and their buffer zones, which cover 5,538 km$^2$; blocks of protected areas are ecologically connected by forest strips along the Churia foothills and Tarai.

Protected areas within TAL are Chitwan National Park (1682.00 km$^2$) Bardia National Park (1475 km$^2$) Shuklaphanta Wildlife Reserve (548.5 km$^2$), Parsa Wildlife Reserve (922.67 km$^2$), Banke National Park (893 km$^2$) and Krishnasar Conservation Area (16.95 km$^2$).

[95] Ministry of Forests and Soil Conservation. 2015. Strategy and Action Plan 2015-2025. Tarai Arc Landscape. Nepal
[96] Ibid.

Wildlife corridors connecting TAL with other protected areas are, Barandabhar Corridor and protection forest, Basanta Corridor and protection forest, Brahmadev Corridor, Kamdi Corridor Karnali Corridor, Khata Corridor and protection forest, Laljhadi-Mohana Corridor and protection forest[97] (Table 22).

Table 22. Wildlife Corridors Connecting TAL with Other Protected Areas

| Corridors | | Forest Corridor/km$^2$ | Impact Zone /km$^2$ | Total Area/km$^2$ |
|---|---|---|---|---|
| Barandabhar | Corridor and protection forest | 148 | 113 | 261 |
| Basanta | Corridor and protection forest | 181 | 471 | 652 |
| Brahmadev | Corridor | 138 | 10 | 148 |
| Kamdi | Corridor | 291 | 159 | 450 |
| Karnali | Corridor | 149 | 78 | 227 |
| Khata | Corridor and protection forest | 74 | 128 | 202 |
| Laljhadi-Mohana | Corridor and protection forest | 202 | 152 | 355 |

Source: Ministry of Forests and Soil Conservation. 2015

The highly productive alluvial grasslands and riverine forests of TAL support Asia's largest herbivores and carnivores. The fauna includes 85 species of mammals, 565 species of birds, 47 species of herpetofauna, and more than 125 species of fish. Key species for conservation in the TAL are tiger (*Panthera tigris tigris*), greater one-horned Rhinoceros (*Rhinoceros unicornis*), swamp deer (*Cervus duvaucelii duvaucelii*), Asian elephant (*Elephas maximus*), blackbuck (*Antilope cervicapra*), Gangetic dolphin (*Platanista gangetica*), gharial (*Gavialis gangeticus*), great hornbill (*Buceros bicornis*), sarus crane (*Grus antigone*), Bengal florican (*Houbaropsis bengalensis*), lesser adjutant stork (*Leptoptilos javanicus*) and several species of vultures. These species are protected by the National Parks and Wildlife Conservation Act 1973.[98]

The ecosystems in TAL range from early successional tall grasslands established in the alluvial floodplain to climax stage sal forest at lower elevations, and broad leaved forest in the Churia range. Major forest ecosystems include sal forest, riverine forest, mixed forest and grasslands. Sal forest is dominated by *Shorea robusta* associated with *Terminalia spp*., *Dillenia pentagyna*, *Careya arborea*, *Lagerstroemia parviflora* and *Buchanania latifolia*. The riverine forest grows along water bodies and is dominated by *Mallotus phillipinensis, Trewia nudiflora* and *Bombax ceiba*[99]. Wooded grasslands have sparsely

[97] Ibid.

[98] Ministry of Forests and Soil Conservation. 2015. Tarai Arc Landscape. Nepal. Strategy and Action Plan 2015-2025

[99] Ibid.

dispersed trees, including *Mallotus phillipinensis, Bauhinia spp., Lagerstromia parviflora* and *Adina cordifolia*. Newly created riverbeds and floodplains are colonized by pioneer species such as *Acacia catechu* and *Dalbergia sissoo*. Rare tree species as satisal (*Dalbergia latifolia*) and bijaysal (*Pterocarpus marsupium*) thrive in the TAL. Tall grassland is dominated by *Saccharum* spp., *Themeda spp., Arundo donax, Phragmites karka* and *Narenga porphyrocoma*. Major aquatic ecosystems include wetlands, rivers and flood plains. Bishazari Lake, Jagadishpur Reservoir and Ghodaghodi Lake are wetlands of international importance. Mahakali, Karnali, Babai, Rapti, Tinau, Narayani and Bagmati are important river systems that drain TAL[100] (all originate outside the landscape).

TAL also harbors dozens of trees and other plant species that yield non-timber forest products (NTFPs), as well as medicinal and aromatic plants. These include *Terminalia chebula, Terminalia belarica, Emblica officinalis, Asparagus racemosus, Acacia concinna, Rauvolfia serpentina, Piper longum, Tinospora cordifolia, Aegle marmelos, Cassia fistula, Centella asiatica, Solanum nigrum, Solanum khasianum, Azadirachta indica* and *Alstonia scholaris.*[101]

**Churia Region**

The Churia region, also known as the Siwalik, extends over 1,898,263 ha, from 80° 9' 25" to 88° 11' 16" longitudes and from 26° 37' 47" to 29° 10' 27" latitudes, and occupies 12.84% of the area of the entire country. The region is spread over 1,896,930 ha, and covers parts of 36 of the nation's 75 districts.

In the late 1960s and early 1970s, Nepal was portrayed as a country facing heavy environmental degradation and deforestation, particularly, in its hilly regions, including the Churia region and blamed for flooding in the Tarai and the Gangetic plains in India and Bangladesh. In response, the Government of Nepal (GoN) formulated the National Forestry Plan of 1976 and later promulgated the Panchayat Forest and Panchayat-Protected Forest Rules in 1978 to encourage local communities to participate in forest conservation and management. However, unlike in the Midhills, only a fraction of the total area of Churia forest was handed over under this system and the rest was managed as government-protected forest. With the successful implementation of community forestry programmes in the Midhills under the Forest Act of 1993 and the Forest Rules of 1995, part of the Churia forest was also handed over as community forest. Currently, there are about 2,837 community forest user groups where a total of 490,547 households are involved. Most of the remaining Churia forest is managed by the government and a fraction of Churia forest is managed as leasehold forest and strictly protected in the Pas of the Parsa and Shukla Phanta wildlife reserves and the Chitwan, Banke, and Bardia national parks. The GoN has emphasized the need to protect the Churia forest since the fourth five-year periodic plan[102].

The elevation of the Churia varies from 93 to 1,955 masl and is a long stretch with the width ranging from 10-50 km. It was formed when fluvial sediments from the Himalaya accumulated during the

[100] Ministry of Forests and Soil Conservation. 2015. Tarai Arc Landscape. Nepal. Strategy and Action Plan 2015-2025
[101] Ibid.
[102] DFRS. 2014. Churia Forests of Nepal. Forest Resource Assessment Nepal Project/ Department of Forest Research and Survey. Babarmahal, Kathmandu, Nepal

Neogene (23–0.6 million years ago) and Quaternary (2.6 million years ago to recent times) eras. Because the Churia is, geologically speaking, the youngest mountain chain of the Himalaya, it is the most erodible and fragile.[103]

The geology of the Churia is tectonic in origin and its rocks comprise north-dipping, semi-consolidated, interbedded tertiary sandstone, siltstone, shale and conglomerate. Low elevation falls in the sub-tropical climatic zone whereas high hill spurs fall within the warm temperate climatic zones. The intensity of rainfall is high in the Churia region where moisture regime is sub-humid in most of the area but humid in the southern aspects of the Western, Central, Eastern Development regions and dun valleys. The climate of Churia region ranges from sub-tropical to warm-temperate and is characterized by hot and sub-humid summers, intense monsoon rain, and cold dry winters. The precipitation pattern in Churia is geographically variable, with the highest annual rainfall in the Eastern and Central Development Regions. The total annual rainfall varies from a minimum of 1,138 mm to a maximum of 2,671 mm.[104]

The major forest types are sal and mixed hardwood forests at low altitudes and pine at high (see Figure 22). The Churia hills are structurally weak and highly vulnerable to erosion and other hazards and this fragility poses challenges not only for people in the Churia but for those who live in downstream lowland areas in the Tarai. Forest-cover mapping has estimated that the Churia region comprise 72.37% (1,373,743 ha) forest, 1.19% (22,672 ha) other wooded land and 26.44% (501,848 ha) other land. The majority of the forest area (76%) was outside protected areas whereas the remaining forest (24%) occurred in protected areas (core zones 18% and buffer zones 6%).[105]

A total of 281 tree species belonging to 177 genera and 71 families; 186 shrub species belonging to 116 genera and 51 families and 322 species of herbaceous plants (including flowering plants and Pteridophyte) belonging to 226 genera and 75 families were recorded, as were 100 species of climbers and 11 species of epiphytic plants belonging to 26 families and 66 genera. A total of 666 different species of flora (240 trees, 144 shrubs, 187 herbs, 70 climbers, 22 ferns and 3 epiphytes) and 74 species of animal derivatives were used as non-timber forest products (NTFPs).[106]

In general, the Churia is characterized by the following features:

- Steep, broken terrain
- Shallow, droughty soils with low surface infiltration and percolation rates
- High-intensity rainfall during the monsoon and tremendous overflow torrents regardless of the degree and nature of vegetation cover

[103] DFRS. 2014. Churia Forests of Nepal. Forest Resource Assessment Nepal Project/ Department of Forest Research and Survey. Babarmahal, Kathmandu, Nepal

[104] Ibid

[105] DFRS. 2014. Churia Forests of Nepal. Forest Resource Assessment Nepal Project/ Department of Forest Research and Survey. Babarmahal, Kathmandu, Nepal

[106] Ibid.

- High insolation and air temperatures during the dry season
- Lack of irrigation and drinking water
- Streams with high rates of discharge during the rainy season and negligible rates of discharge at other times.

**Kulekhani Watershed**

Kulekhani watershed, the source for the Kulekhani reservoir supplying downstream hydropower plants, is located 50 km southwest of Kathmandu. The 92 MW Kulekhani hydropower plant generating approximately 17% of the total hydroelectric power in Nepal is the only storage-based hydropower plant in the country. A third stage, currently under construction, will generate 45 MW in the near future[107].

The Kulekhani watershed consists of an uneven terrain comprising steep hills and narrow valleys. There are eight villages with about 8000 households and over 45,000 residents in the catchment area of the watershed. Most of the households depend on agriculture and livestock while intensive agriculture for commercial vegetable production and rice production is on the increase. The reservoir depends on water from the 12,500-hectare watershed and the four months of monsoon account for around 80% of annual precipitation. Within the watershed there are settlements and various land uses. The Kulekhani hydropower plant faces problems of high sedimentation in the rivers and low dry season flow[108]. The upstream land-use pattern directly affects the water storage capacity of the reservoir as sedimentation, caused by intensive agriculture and land disturbance, is the main problem. The amount of water in the lake determines the amount of electricity that can be produced and sedimentation not only reduces the volume of water in the lake, but the cost of regular de-siltation is also significant.

The Government of Nepal considering Kulekhani lands as 'critical watershed of strategic importance', has adopted a more proactive role through 'participatory watershed conservation programs. As the protection of forests by community forest users contributes to reducing siltation, the Kulekhani Watershed Conservation and Development Forum was established to facilitate communication between different stakeholders and to promote conservation. The forum succeeded in developing an “environmental services payments” mechanism based on the Local Self-Governance Act 1999 and the Decentralization Act 1992[109]. Community forests in the watershed are well protected and forest cover has increased over the last two decades[110]

[107] Joshi, L .2016. World Agroforestry Centre. http://rupes.worldagroforestry.org/rupes-sites/nepal/kulekhani. Accessed 30 Dec 2016

[108] Joshi, L .2016. World Agroforestry Centre. http://rupes.worldagroforestry.org/rupes-sites/nepal/kulekhani. Accessed 30 Dec 2016

[109] Joshi, L .2016. World Agroforestry Centre. http://rupes.worldagroforestry.org/rupes-sites/nepal/kulekhani. Accessed 30 Dec 2016

[110] RUPES Program. 2008. The World Agroforestry Centre (ICRAF). http://www.worldagroforestrycentre.org/sea/Networks/RUPES/index.asp. Accessed 1 Dec 2016

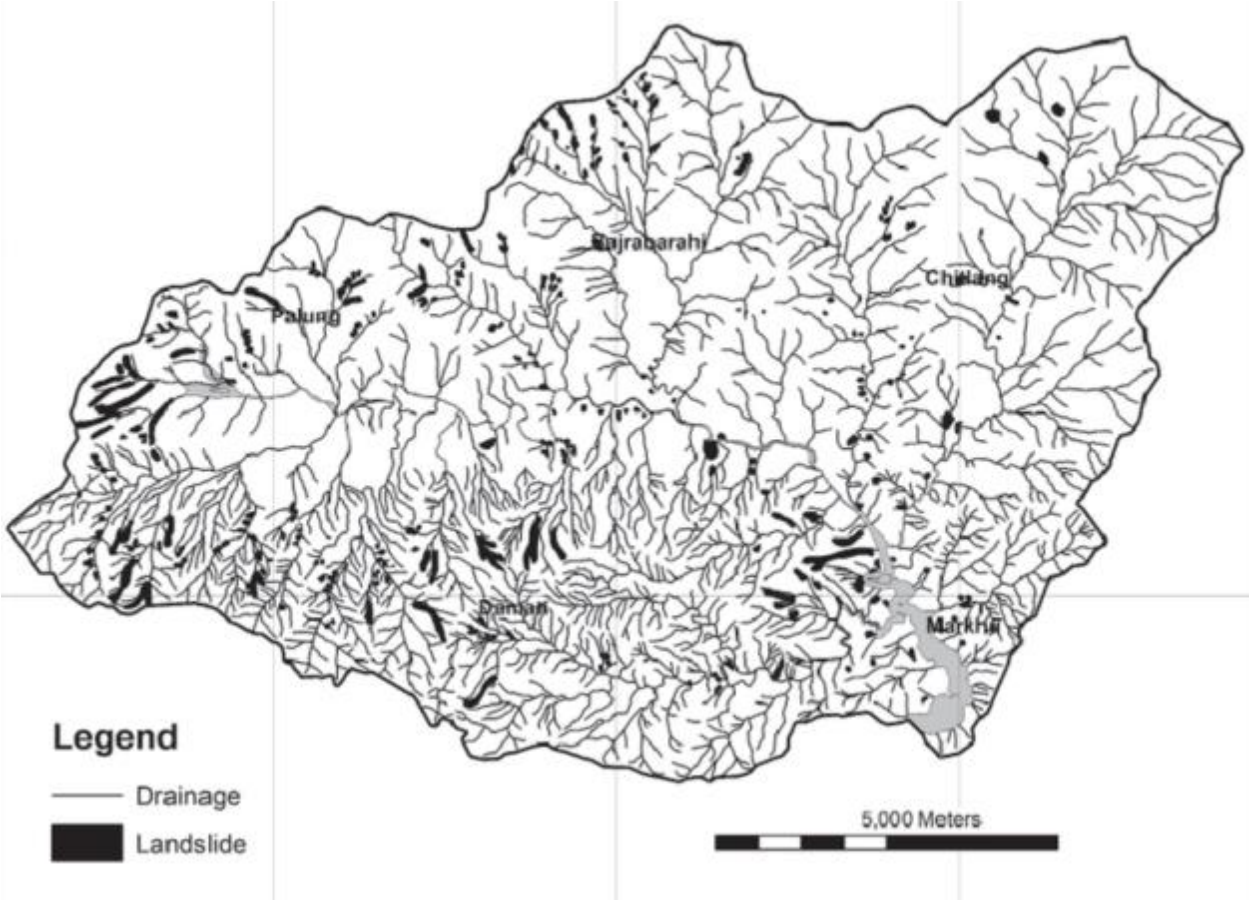



Figure 15. Kulekhani Watershed

### 4.1.13 Biodiversity

Nepal's biodiversity is a reflection of its unique geographic position and variations in altitude and climate. The wide range of climatic conditions that exist in Nepal, mainly as a result of variations in altitude, have been described previously above. Here, the climatic divisions are described in terms of their reflection in contrasting habitats, vegetation, and fauna.

Biodiversity in Nepal can be examined at the ecosystem, genetic and species levels in both wild and cultivated areas. At the ecosystem level, Nepal has wide diversity and contains 118 ecosystems. Eighty of these ecosystems are represented in the 17 protected areas with varying degrees of coverage. Table 23 and 21 present the number and linkages of the ecosystems to protected areas.

Genetic level studies of biodiversity of wild species in Nepal are almost non-existent. However, some information is available for cultivated species. For example, rice is widely distributed with more than

2,000 land races varying in maturity, photoperiod sensitivity, grain size and quality and resistance to various environmental stresses.[111] At the species level, Nepal supports a very high level of biodiversity. The transitional location between the Palaeoarctic and Indo-Malayan zones and the variety of landscapes and ecosystems have contributed to this richness in the biodiversity.

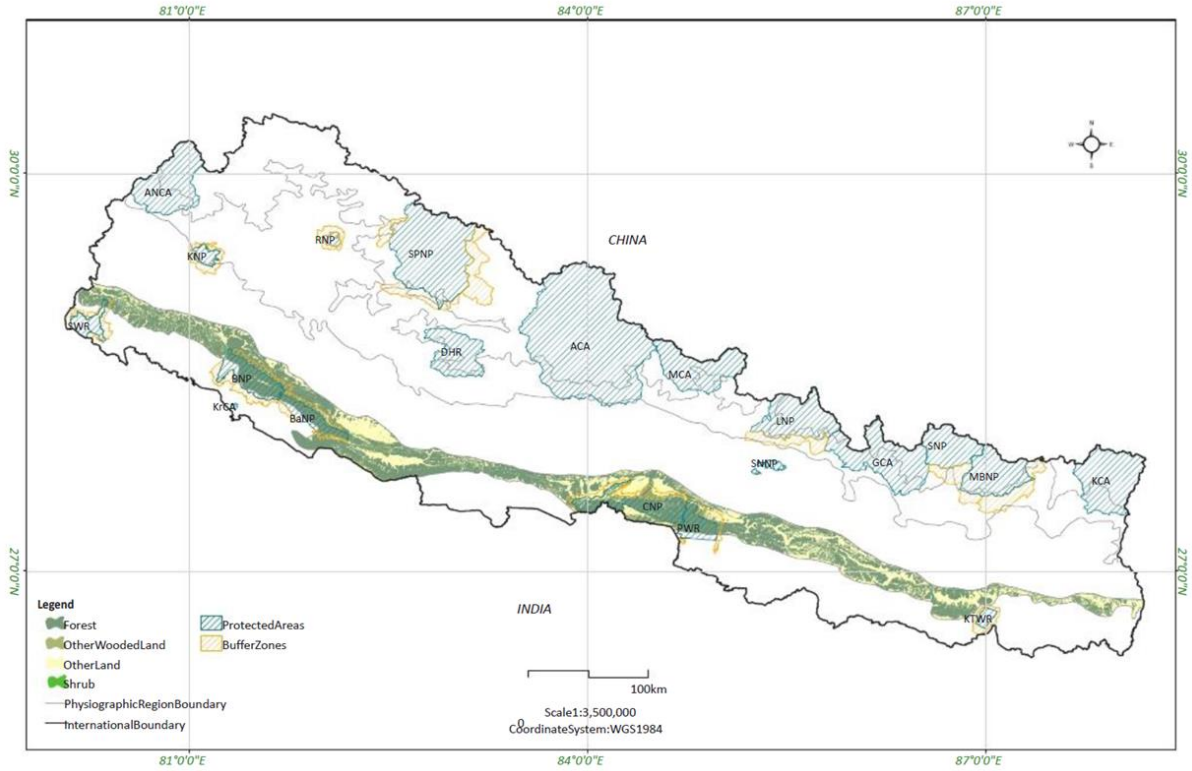



**Figure 22. Churia Region with Forests**
Source: DFRS. 2014

Table 23. Physiographical Linkages of Protected Areas

| Physiographic Zone | Protected Area |
|---|---|
| Tarai | Royal Chitwan NP, Royal Bardia NP, Koshi Tappu WR, Prasa WR, Suklaphanta WR |
| Siwaliks | Royal Chitwan NP, Royal Bardia NP, Parsa WR |
| Mid Hills | Shivapuri WR, Khaptad NP, Makalu Barun CA, Annapurna CA |
| High Mountains | Makalu Barun NP and CA, Sagarmatha NP, Langtang NP, Dhorpatan HR, Rara NP, Khaptad NP, Shey-Phokshundo NP, Annapurna CA |
| High Himalayas | Makalu Barun NP and CA, Sagarmatha NP, Langtang NP, Annapurna CA |

Source: FAO, 2000

[111] FAO. 2000. FRA 2000 - Forest resources of Nepal, country report

Table 24. Representation of Ecosystems in Protected Areas

| Physiographic Zone | Number of Ecosystems in Protected Areas | |
|---|---|---|
| | Total | Represented |
| Tarai | 10 | 10 |
| Siwaliks | 13 | 5 |
| Midhills | 52 | 33 |
| Highlands | 38 | 30 |
| Others | 5 | 2 |
| Total | 118 | 80 |

Source: FAO, 2000

Considering species, Nepal's 35 vegetation types support a rich biodiversity in terms of fauna and flora. Nepal has a large number of mammalian, bird, butterfly, invertebrate species, flowering plants, and a large number of ferns. Several of these have become endangered as a result of various factors, including deforestation.[112] About 18% of the land area has been demarcated as protected and conserved areas. Proper management of the protected areas for biodiversity conservation, poverty reduction, and livelihood improvement is a necessity.[113]

The biodiversity of Nepal is also reflected in its agriculture and livestock. For example, the principal agricultural crops include rice (45%), maize (20%), wheat (18%), millet (5%), oilseeds (5%) and potatoes (3%). Other crops include barley, sugarcane, jute, tobacco, cotton, tea, vegetables, and fruits.[114]

The latest physiographic data show around 4.27 million ha (29% of total land area) of Nepal's land surface is mature forest; 1.56 million ha (10.6%) is scrubland and degraded forest; 1.7 million ha (12%) is grassland; 3.0 million ha (21%) is farmland, and about 1.0 million ha (7%) is uncultivated land. Nepal had a human population of 23.2 million at the most recent census in 2001 but has been increasing at an annual rate of about 2.5%. Some 48.5% of the population lives in the Tarai, 44.2% in the Hills, and 7.3% in the Mountains.[115]

Nepal covers only 0.1% of the surface area of the world but supports an exceptionally high proportion of global biodiversity.[116] A total of 6,391 flowering plant species or 2.76% of the world total have been recorded in Nepal. The total number of mammals is 208 (3.96% of world total), of birds, 865 (8.9%), of

[112] Charles Sturt University. 2012.Environment and Culture in Nepal: Optimising the needs of Protected Areas, Threatened Species and Human Livelihoods

[113] Ibid.

[114] FAO. 2000. FRA 2000 - Forest resources of Nepal, country report

[115] Charles Sturt University. 2012.Environment and Culture in Nepal: Optimising the needs of Protected Areas, Threatened Species and Human Livelihoods

[116] Ibid.

reptiles, 195 (1.54%) and of amphibians, 118 (2.47%) and of fish, 206 species. The diversity of some invertebrate groups is also exceptionally high. For example, 653 species of butterflies have been recorded, representing 3.72% of the world total. Nepal has a total of 17 protected areas. Eleven of the protected areas also have associated buffer zones. The total area protected, including the buffer zones, covers 28,960 $km^2$, or 19.7% of the land surface of the country. Thirty-six major vegetation types have been described across Nepal, of which 31 are well represented in protected areas.[117]

About 571 plant species have been confirmed as medicinal plants. Out of these species about 30% are trees, 25% shrubs, 32% herbs, 10% climbers and 3% other. However, documented information about the utility, collection, drying and storage of medicinal plants is available only for 97 species.[118]

Nepal has a large number of fruit-producing plants. Citrus is the major fruit crop of Nepal. Varieties of citrus commercially grown in Nepal are derived local germplasm. Mango, guava, litchi, jackfruit, pomegranate, orange, banana and apple are the main fruits grown in the country. The Plant Genetic Profiles Study (1995) listed 96 indigenous fruits. The study indicated that 42 main fruits and nearly 195 varieties are grown in Nepal. The study indicates that 14 fruits, wild pear (mayal), sand pear (chiniya naspati), quince (Nepali syau), darim, dakh, persimmon (haluwabed), peach (aru), plums (arubakhara), citron (bimiro), sweet lime (chaksi), fortunella (muntala), lapsi, thin shelled walnut (dante-okhar) and castanea (deshi-katus) are genetically threatened. About twenty-one government and private horticulture farms collect and maintain fruit germplasm. These farms currently maintain about 618 varieties of fruit.[119]

Faunal diversity is equally impressive with about 175 mammal species, 836 bird species, 147 reptile and amphibian species, 180 species of fish, 640 species of butterflies, and over 6 000 species of moths. Of these, 26 mammals, nine birds, and three reptiles are endangered, vulnerable, or threatened. For example, gharial (*Gharialis gangeticus*), Bengal florican (*Eupodotis bengalensis*), florican (*Sypheotides indica*), Gangetic dolphin (*Platanista gangetica*), hispid hare (*Caprolagus hispidus*), red panda (*Ailurus fulgens*), clouded leopard (*Neofelis nebulosa*), snow leopard (*Panthera unicia*), tiger (*Panthera tigris*), Asian elephant (*Elephas meximus*), one-horned rhinoceros (*Rhinoceros unicornis*), musk deer (*Moschus moschiferus*), barasingha or swamp deer (*Cervus duvauceli*), and wild buffalo (*Bubalus bubalis*) are threatened species in Nepal.

Nepal supports a large number livestock (domestic animal) species. The spatial distribution of the different species varies with environmental conditions, socio-economic constraints and the capacity of the land to produce feed. Cattle are predominant in the lower hills and Tarai, while buffalo are more common in the Middle Mountains of the central and western regions. Goats are concentrated in the eastern and central hills and sheep are predominant in the western hill and mountains. Variation in domestic cattle species by altitude is quite significant. For example, in the mountains and the hills region

[117] Ibid.

[118] FAO. 2000. FRA 2000 - Forest resources of Nepal, country report

[119] Ibid.

the main cattle species and varieties include kirko, cholung (*Bos indicus*), achham zebu, black zebu, siri, and kachcha siri. In the central Tarai region the common species of cattle are hariana (*Bos indicus*) and bachaur (*Bos indicus*). Cattle as kherigarh zebu and ponwar zebu predominate in the southern part of Tarai. Similar variations can be observed in the case of sheep and goats. Local people use wild genetic resources to improve established domesticates. For instance, in the high mountain areas the semi-wild yak (*Bos grunniens*) is regularly bred with domestic cows to produce the hybrid chaunri, a good milk producer.[120]

### 4.1.14 Forests

The national forests of Nepal are classified into seven categories: protected areas, community forests, lease-hold forests, religious forests, collaborative forests, conservation forests and government managed forests. The last category includes those national forests that do not fall under any other category. This category covers about 90% of the forests in the country. The Department of Forests has not classified any forests as protection forests. All types of national forests are required to be managed under a management plan. The Department of Forests has responsibility for sustainable management of all forest resources, including government managed forests.

Phyto-geographically, Nepal is located in the Oriental Region and according to the Conservation Science Program WWF-US (1998) classification; Nepal has 12 eco-regions as presented in Table 25.[121]

Table 25. Eco-regions in Nepal

| Vegetation type | Eco-region | Altitude |
|---|---|---|
| Montane grasslands and shrub lands | Trans-Himalayan alpine shrub/meadow | |
| | West Himalayan alpine shrub/meadow | 3,700–4,400 m |
| | East Himalayan alpine shrub/meadow | 4,000–4,500 m |
| | North-west Himalayan alpine shrub/meadow | Above 4,000 m |
| Sub-alpine conifer forest | Trans-Himalayan sub-alpine conifer forest | |
| | West Himalayan sub-alpine conifer forest | 3,000–4,000 m |
| | East Himalayan sub-alpine conifer forest | 3,000–4,000 m |
| Temperate broadleaved forest | West Himalayan broadleaved forest | 1,500–3,000 m |
| | East Himalayan broadleaved forest | 1,500–3,000 m |
| Tropical forests/subtropical conifer forest | Himalayan sub-tropical pine forest | 1,000–2,000 m |

[120] Ibid.

[121] DFRS, 2015. State of Nepal's Forests. Forest Resource Assessment (FRA) Nepal, Department of Forest Research and Survey (DFRS). Kathmandu, Nepal.

Table 25. Eco-regions in Nepal

| Vegetation type | Eco-region | Altitude |
|---|---|---|
| Sub-tropical broadleaved forest | Himalayan sub-tropical broadleaved forest | 500–1,000 m |
| Grasslands, savannahs and shrub lands | Tarai-Duar savannahs and grassland | Below 500 m |

Source: DFRS, 2015

Stainton (1972) identified 35 forest types in Nepal, largely based on Champion (1936). These 35 types are often categorized into 10 major groups: 1) tropical, 2) sub-tropical broadleaved, 3) sub-tropical conifer, 4) lower temperate broadleaved, 5) lower temperate mixed broadleaved, 6) upper temperate broadleaved, 7) upper temperate mixed broadleaved, 8) temperate coniferous, 9) sub-alpine and 10) alpine scrub.[122] The Biodiversity Profile Project has identified a total of 118 ecosystems and classifies Nepal into 4 domains and 11 sub-levels and provides six vegetation categories based on an altitudinal classification (bio-climatic zones). The six vegetation categories are described below.

Tropical Zone (below 1 000 masl)

The forests in this zone are located in the Tarai and the Siwalik (Churia) hills. Broadleaved forests dominate this zone except for some coniferous forests (*Pinus roxburgii*) on southern aspects in the upper regions. This zone accounts for a total of 1,829 species of flowering plants and about 81 species of Pteridophytes.

The Tarai covers about 14% of Nepal's area and there are significant differences in the flora of the western and eastern parts due to difference in climate, rainfall and soil type. Eastern Nepal is characterized by the presence of *Cycas pectinata, Gnetum montanum, Calamus spp., Cythea spinulosa, Pandanus nepalenses* and permanent grasslands locally known as Phanta, while the western Nepal vegetation is characterized by the presence of *Pinus roxburghii*.

The Siwalik range (Churia hills) occupies about 13% of the total land area of the country. Typical vegetation in this region includes *Cycas pectinata, Gnetum montanum, Duabanga grandiflora, Calamus spp., Cythea pinulosa, Pandanus nepalensis*, and *Podocarpus neriifolius*.

*Shorea robusta* (sal) dominates the whole of the Tarai region. It is accompanied by *Adina cordifolia, Aegle marmelos, Albizia spp., Anthocephalus chinensis, Anogeissus latifolia, Butea frondosa, Dillenia pentagyna,* and *Dillenia indica*. Wherever sal is absent or less prevalent *Lagerstroemia parviflora, Garuga pinnata, Mitragyna parvifolia, Schleichera oleosa, Terminalia bellerica, Terminalia chebula,* and *Terminalia alata* form forests along with *Holarrhena pubescens* and *Mallotus philippensis*. In the riverine

[122] DFRS, 2015. State of Nepal's Forests. Forest Resource Assessment (FRA) Nepal, Department of Forest Research and Survey (DFRS). Kathmandu, Nepal

areas, these species are replaced by *Acacia catechu, Dalbergia sissoo, Dalbergia latifolia, Syzygium jambos*, and *Eugenia operculata*. Some of the other common trees of this tropical zone are *Albizzia procera, Alstonia scholaris, Bombax ceiba, Bridelia retusa, Callicarpa arborea, Cassia fistula, Casearia graveolens, Dillenia indica, Ficus spp., Kydia calicyna Lannea coromandalica, Macaranga denticulata, Oroxylum indicum,* and *Semicarpus anacardium*.

Subtropical Zone (1,000 to 2,000 masl)

This zone covers the central belt that lies north of the Shiwaliks and is composed of a network of ridges. The subtropical forest consists of species such as *Schima wallichii, Castanopsis indica,* and *Castenopsis tribuloides* on relatively humid areas while *Pinus roxburghii* forms forests in drier regions. Conifer forests are dominated by species like *Tsuga dumosa (thingre salla), Pinus roxburghii (ranisalla) and Pinus wallichiana (gobre salla)* with patches of *Quercus spp, and Rhododendron spp.* This zone consists of more than 1,945 flowering plant species. Some common forest types in this region include *Castanopsis tribuloirdes* mixed with *Schima wallichi*, *Rhododendron spp., Lyonia ovalifolia, Eurya acuminata, and Quercus glauca; Castanopsis-Laurales forest with Symplocas spp.; Alnus nepalensis forests; Schima wallichii-Castanopsis indica hygrophile forest; Schima-Pinus forest; Pinus roxburghii forests with Phyllanthus emblica. Semicarpus anacardium, Rhododendron arboreum and Lyoma ovalifolia; Schima-Lagestromea parviflora* forest, *Quercus lamellosa* forest with *Quercus lenata* and *Quercus glauca*; *Castononpsis* forests with *C. hystrix and Lauraceae; mesohygophile* forests with *Quercus galuca* and *Quercus lanata*.

Associations of Lauraceous species are common in broadleaved forests; for example, *Litsea spp., Enlistee cupola, Persia odoratissima, Persea duthiei, etc., along with such others as Engelhardtia spicata, Rhododendron arboreum, Lyonia ovalifolia, Pyrus pashia, Rhus spp., Acer oblongum, myrica esculenta, Michelia kisopa,* and *Betula alnoides.*

Some other common trees and large shrub species of subtropical forests are *Semicarpus anacardium, Cretaeava unilocularis, Trewia nudiflora, Premna interrupta, Ulmus lancifolia, Ulmus chumlia, Glochidium velutinum, Callicarpa arborea, Toona ciliata, Ficus spp., Mahosama similicifolia, Trevesia palmate, Xylosma longifolium, Boehmeria rugulosa, Scheffera venulosa, Michelia spp., Casearia graveilens, Rhus wallichii, Actinodaphne reticulata, Sapimum insegne, Alns nepalensis, Ardisia thyrsiflora, Ilex spp, Macaranga pustulata, Trichilia cannoroides, Celtis tetranda, Wenlendia puberula, Saurauia nepalensis, Ligustrum confusum, Quercus glauca, Zizyphus incurva, Camellia kissi, Hymenodictyon flaccidum, Maytenus thomsonii, Zanthoxylum armatum, Rhus succednea, Eurya acuminata, Myrsine semiserrata, Slonea tomentosa, Hydrangea asper, Symplocus spp., Cleyrea spp.* and *Quercus lamellose.*

Temperate Zone (2,000 to 3,000 masl)

This zone supports broadleaved evergreen forest dominated by plants such as *Quercus lamillosa* and *Q. semicarpifolia* in pure or mixed stands. Species such as *Lindera* and Litsea. *Tseuga dumosa* and *Rhododendron spp.* are also present in the upper levels of this zone. Other important species are *Magnolia campbellii, Michelia doltsopa, Pieris ovalifolia, Daphnephyllum himalayanse, Acer campbellii, A. pectinatum,* and *Sorbus cuspidata* but these species do not extend toward the west beyond central

Nepal. *Alnus nepalensis*, a pioneer tree species, grows gregariously and forms pure patches of forests on newly exposed slopes, gullies, moist places and on riversides.

The common forest types of this zone include *Rododendraon arboreum, Rohododendron barbatum, Lyonia spp., Pieris Formosa; Tsuga dumosa* forest with such deciduous species as *Acer and Magnolia;* deciduous mixed broadleaved forest of *Acer campbellii, Acer pectinatum, Sorbus cuspidata,* and *Magnolia campbellii*; mixed broadleaved forest of *Rhododendron arboreum, Acer campbellii, Symplocos ramosissima* and *Lauraceae*.

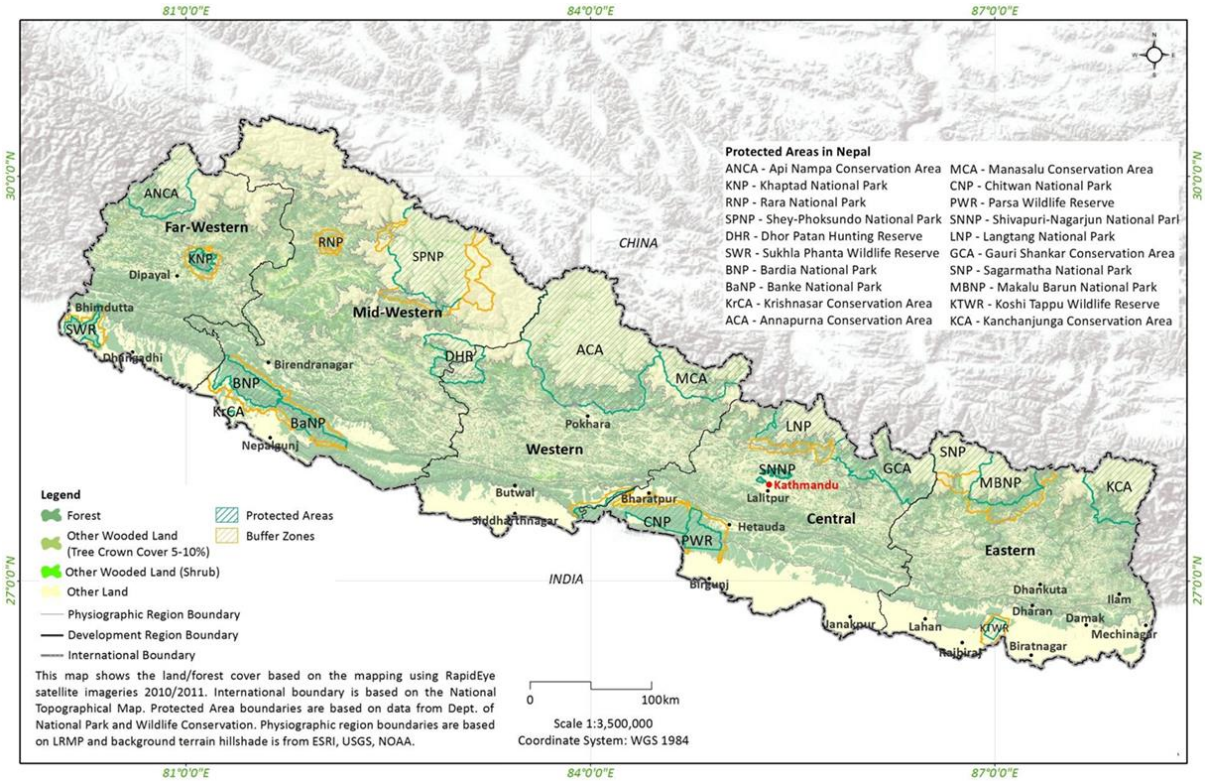



**Figure 23. Forest Cover with Protected Areas of Nepal**

This zone is habitat for many other important tree and large shrub species such as *Abies pindrow, Betula utilis, Buxus rugulosa, Benthamidia capitata, Corylus ferox, Deutzia staminea, Euonymus tingens, Abies spectalbilis, Acanthopanax cissifolius, Acer campbellii, Acer pectinatum, Betula alnoides, Coriaria terminalis, Fraxinus macrantha, Dodecadenia grandiflora, Eurya cerasifolia, Hydrangea heteromala, Ilex dipyrena, Ligrestum spp., Litsea elongata, Juglans regia, Lichelia doltsopa, Myrsine capitallata Neolitsea umbrosa, Philadelphus tomentosus, Osmanthus fragrans, Prunus cornuta, Rhododendron companulatum, Sorbus cuspidate,* and *Vibernum continifolium*.

Sub Alpine Zone (3,000 to 4,000 masl)

The sub alpine zone covers about 43% of the land but accommodates only 6% of Nepal's population. This zone supports forest vegetation up to the tree line with more than 1,400 unique flowering plants. The number of unique plants are unique is increasing with identification of more species. Further, 177 out of a total of 246 endemic plants in Nepal belong to this zone. Many medicinal species such as Aconites, Allium, Bergenia, Ephedra, Daphne, Betula, Paris, Picrorhiza, Swertia and Taxus that are important to the rural society and economy of Nepal are found in this zone and used by local people.

The Betula-*Rhododendron campanulatum* and *Abies spectabilis* forest represents the vegetation of this zone. *Rhododendron spp*. forms a mixed forest within Abies or Betula forest or occurs as open shrub. Some important trees and shrub species of this zone include *Sorbus cuspidata, Euonymus tingens, Ribis glaciale, Acer pectinatum. Salix spp., Lyonia spp., Prunus rufa, Acer candatum, Acanthopanax cessifloia, Sorbus microphylla,* and *Berberis spp*. The *Juniperus spp*. occurs in the drier forest areas of this zone.

Alpine Zone (4,000-5,000 masl)

The alpine forest is characterized by the presence of various stunted bushy shrubs. The main species are *Rhododendron setosum, R. anthopogon, R. lepidotum, Potentilla fruiticosa, Ephedra gerardiana, Berberis spp.* and *Cotoneaster accuminata*. In river valleys *Hippophae spp.* and *Salix spp.* along with *Saxifraga, Arenaria* and *Androsace* species and alpine grasses are found. Some common and important herbs of this zone include *Primula spp., Gentiana spp., Corydalis spp.* and *Saussurea spp*.

Nival (above 5,000 masl)

The Nival zone consists of permanent snowfields, rocks, glaciers and ice on the high Himalayan ranges in the north. The area lies under permanent snow and is mostly without vegetation except for some Lichens on exposed rocky places and few flowering plants such as Stellaria decumbens. This zone also supports species like *Androsace, Sassurea, Primula*, and *Arenaria* that complete their life cycle within three to four months during the rainy season.[123]

Forest Area

In Nepal, forests cover 5.96 million ha (40.36%), Other Wooded Land (OWL) covers 0.65 million ha (4.38%) and Other Land covers 8.16 million ha (55.26%). Forest and OWL together comprise 44.74% of the total area of the country. Out of the total forest area of Nepal, 37.80% lies in Middle Mountains region, 32.25% in High Mountains and High Himal, 23.04% in Churia and 6.90 in the Tarai. The Mid-Western Development Region has the highest (26.68 %) forest cover of Nepal, whereas Far-Western Development Region has the lowest (16.94 %) of the total forest area. Out of the total forest area of the country, 4.93 million ha (82.68%) lies outside Protected Areas and 1.03 million ha (17.32%) inside protected areas.[124]

[123] FAO. 2000. FRA 2000 - Forest resources of Nepal, country report.

[124] DFRS, 2015. State of Nepal's Forests. Forest Resource Assessment (FRA) Nepal, Department of Forest Research and Survey (DFRS). Kathmandu, Nepal.

Accessible Forests

The National Forest Inventory (NFI, 1999) classifies a forest as inaccessible, if it is located on a slope steeper than 45 degrees, has some physical obstacles or is inside a protected area. About 51.5% of the forest areas in Nepal are accessible. Figure 25 provides the area of accessible forest by altitude classes.

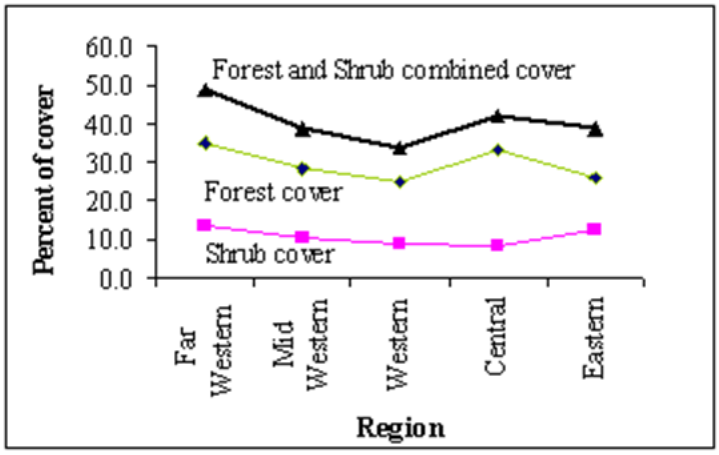



**Figure 24. Vegetation Cover by Development Region**

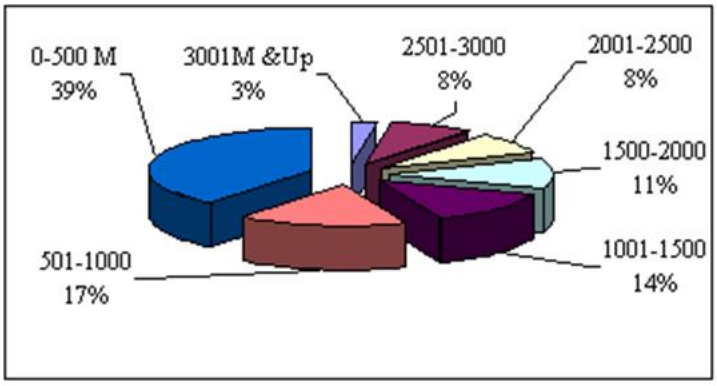



**Figure 25. Accessible Forest by Altitude Class**
Source: FAO (2000)

The Eastern development region has the maximum area (576,300 ha) of accessible forest and the Western development region has the least (262, 100 ha). The Far Western development region has the greatest per-hectare growing stock (200 $m^3$ per ha) of accessible forests, while the Mid-Western region has the least (157 $m^3$ per ha).[125]

[125] FAO. 2000. Forest resources of Nepal, country report

Deforestation and Degradation

The last national forest inventory concluded that the absolute figure of deforestation over the reference period was highest in Kailali (16,000 ha). The two districts where the forest area appears to have increased were Dhanusha (600 ha) and Siraha (200 ha.). The total forest area in the Tarai zone was 1.4 million hectares with an annual deforestation rate of about 1.3% as against the previous rate of 3.9% according to the Master Plan for the Forestry Sector of Nepal for the period 1978-1979 to 1985-1986. Apart from deforestation, land degradation is a serious problem in Nepal. There is extensive soil erosion, particularly in the Kathmandu valley and the Mahabharat Lekh area.

Plantations

Until the early 1980s plantation activity was mostly on government forest lands rather than private or community lands. From the mid-1980s onward the situation has changed and plantation activity is now many times more on common on community and private lands than on government lands.[126] This increase in tree planting, particularly by individuals and communities, demonstrates positive a commitment toward restoration of degraded lands and forests and indicates a trend toward potential long-term sustainability.

Forest Management

For management purposes, the forests of Nepal are classified as "private" or "national" based on ownership of the land on which the trees are growing. Under the current Forest Act, private forest owners need to register their forests with the respective District Forest Office and the program is coordinated by Community Forestry Division of the Department of Forests. Until June 1998 only 1,500 ha of private forest had been registered. However, as of October, 2016 there were 2458 private farmers registered in 54 districts. The total area registered as private forests were 2360 ha.[127]

About 1,798,733 ha of forests has been transferred to forest user groups and about 18,960 Operational plans have been developed for managing community forests that have been transferred to forest user groups.[128] Often the transferred forest areas are degraded forests. Most of the community forests are in the Hill Region. The Tarai Region has comparatively very few community forests. Table 58 at Appendix provides information on forest types and areas of community forests at the time they were handed over to communities. The area of forest given to each user group is highest in Eastern region (98.7 ha) and lowest in the Western region (44.0 ha). The maximum participation of households in community forestry is in the Western Development Region. The condition of most of the community forests is reported to be good with adequate regeneration.[129]

[126] Ibid.

[127] CFD. 2016. Community Forest Database. Community Forest Division, Department of Forests

[128] Ibid.

[129] Ibid.

There is no management plan for the category of the religious forests because the Department of Forests has so far not registered any forests under this category. These are the forests that are being given by the Department to religious groups for their use.

Many Forest Management Plans have been developed for the category of government forests. However, the Department of Forests has not yet been able to implement any of them. During last decade, forest management strategies in Nepal have become more conservative. For example, the 19 operational forest management plans prepared for 19 Districts to manage 628,301 hectares of government forests allocate about 50% of the forests for protection purposes.

The GoN pays special attention to management of protected areas through legislation, management plans and special institutions to meet their needs. The Department of National Parks and Wildlife Conservation (DNPWC) coordinates and implements all activities related to wildlife management in national parks, wildlife reserves and conservation areas. The DNPWC is the national center for two international conventions – the Convention on Wetlands of International Importance, especially as Waterfowl Habitat (Ramsar Convention) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

*Community forestry:*
Community forestry in Nepal is a participatory forest management system which was started in the late 1970s. Community forestry has been defined as the control, protection and management of forest resources by rural communities for whom trees and forests are an integral part of their farming systems[130]. It involves the participation and collaboration of various stakeholders including the local community, government and non-government organizations (NGOs). The local community plays a significant role in the management of the forests and land use decision-making by themselves in facilitating the support of government as well as acting as change agents.

In a forest user group, there are rich, medium and poor households. The contribution of rich and poor households to community forest protection and management is equal. Forest products such as tree and grass fodder, fuelwood and timber etc. are used to meet user's subsistence needs and to generate income from the sale. Group incomes are also raised from monthly membership fees, fines and penalties, and donations from various organizations. Forest user groups use this amount to undertake community development activities such as irrigation canal improvement, community building, school and temple construction, drinking water schemes and foot trail improvement[131].

The Community Forest Act 1993 gives local people significant control in the management and harvest of forest resources. The process of handing over forest areas to be managed as community forests has speeded up rapidly during the early years. By 2001 about 850,000 ha of forest areas had been handed

[130] Joshi M R. 2005. Paper Submitted to X11 World Forestry Congress.2003. http://www.fao.org/docrep/ARTICLE/WFC/XII/0036-A1.HTM#fn1 Accessed 25 Dec 2016
[131] ibid

over to eleven thousand forest user groups[132]. And as of October 2016, 18,960 community forest user groups (CFUGs) had been established and 1,798,733 ha handed over as community forests[133].

In the mid-hills of Nepal, community forestry programs have played an important role in improving forest condition by adopting better forest protection and management measures[134]. Through forest management, users are generating incomes that are used in community development activities. In community forests, free access to collect forest products has been restricted in order to improve the forest condition. This has resulted in a decrease of forest product supply, including tree and grass fodder from the community forest. It has directly affected poorer households practicing livestock farming. Forest resources are very important for them in maintaining their livestock population needed for generating income for survival, as they have small landholdings that are not sufficient to grow tree and grass fodder to support their livestock[135].

*Leasehold forestry:* Leasehold forestry has been successful in enhancing various livelihood capitals of the poor through increased livestock production, rehabilitated degraded land and saved time in collecting forest products[136]. Contrary to the community forestry instrument, leasehold forestry can be fine-tuned to specifically target the most resource poor households within rural communities. It can be used to increase their resource base and thereby contribute to more sustainable livelihoods. To achieve these objectives degraded forest is leased for 40 years (renewable) to groups of poor households as a resource base for their exclusive use. Between 1993 and 2001, some 7000 ha of degraded forest had been leased to about 1600 leasehold forestry groups consisting of more than 11000 poor families, who each received about 0.6 ha forest land. As of October 2016, 7,103 Leasehold Forestry Groups has been formed with the participation of 67,055 households and a total of 41,852.54 ha of national forests has been handed over.[137]The Department of Forests has the main responsibility with regard to the leasing procedures, the Department of Livestock Services provides technical support concerning fodder and livestock development, the Agricultural Development Bank of Nepal provides credit to leasehold farmers, and the Nepal Agricultural Research Council carries out applied research.

In some sites, leasehold forestry groups intensively manage and expand the area of planted fodder grasses and legumes, or develop fruit orchards. With the regeneration of the vegetation, farmers have increasingly been able to harvest forest products where little or none was produced before. This is the case for fodder, animal bedding material (foliage and leaf litter) and fuelwood. Household surveys indicate that the scarcity of animal feed significantly decreased, while the herd size slightly increased (Thompson 2000). As the leaseholders have a sense of ownership of the forestlands, they ensure the

[132] ibid

[133] Tamrakar. Shanta Muni. Nelson, De Von. 1991. Potential community forestry land in Nepal. Ministry of Soil and Forestry Conservation, Nepal (Kathmandu)

[134] ibid

[135] Joshi M R. 2005. Paper Submitted to X11 World Forestry Congress.2003. http://www.fao.org/docrep/ARTICLE/WFC/XII/0036-A1.HTM#fn1 Accessed 25 Dec 2016

[136] Bhattarai, Dhungana, Kafley. 2007. Poor-Focused Common Forest Management: Lessons from Leasehold Forestry in Nepal. Journal of Forest and Livelihood 6(2) September, 2007

[137] DoF. 2016. Leasehold Forest Database. Department of Forests. Nepal

sustainable resources use while practicing cultivation of both forest and non-forest annual crops under agroforestry.

*Collaborative Forest Management:* In Collaborative Forest Management forests are managed sustainably by user households in collaboration with the government. Unlike community-owned and leasehold forests, this new approach focuses on sustainability, productivity and equity, empowering users to manage forests scientifically. The users can prone mature trees, fell old ones and replace them with new saplings so that they can be involved in the whole process and contribute to the regeneration and sustainability of the forests. As against the earlier approach of only focusing on protecting forests, the introduction of the scientific forest management approach has enabled the users to reap economic, social and environmental benefits.[138] The collaborative approach of management has aptly demonstrated that natural resources, including forest, are public property and the public should be allowed to reap the benefits of their contribution towards sustainable management of the resources. This scientific forest management approach is piloted in some areas in Tarai by the GoN to achieve multitude of benefits associated with conservation efforts. However, while some forest experts have stressed on the need of scientific and sustainable forest management, the Nepal Foresters' Association has shown serious concern over the new approach arguing that it is likely to promote haphazard cutting down of trees in lack of proper monitoring.[139]

*Conservation Forests:* Taking into cognizance that some forests of national and international importance with unique biological and cultural values exist in the country and these hotspots need specialized management and operational strategies GoN has embarked on a novel approach to protect these important forest areas. Restoration rehabilitation and conservation of these hotspots together with the corridor and connectivity areas is the primary focus of the concept of conservation forestry. The forests managed under this category include identified corridors, bottlenecks and some critically important forests of the hills. Some of the interventions implemented under conservation forestry are:

- Species conservation activities that include anti-poaching
- Specific habitat improvement for large mammals as one horn rhinoceros and grassland management for the maintenance of Tiger's prey base etc.
- Livelihood improvement activities including support to local cooperatives and income generation from green enterprises
- Sustainable forest management including forest management for fuel wood and timber
- alternative energy promotion to reduce pressure in the forests
- Private plantations, support to livestock improvement and management.[140]

[138] MSFP. 2016. Scientific Forest Management Initiatives in Nepal MSFP Experiences and lessons learnt

[139] Ibid.

[140] Protection Forest: A New Dimension for Biodiversity Conservation, Sustainable Forest Management and Livelihood Improvement http://www.nepjol.info/index.php/INIT/article/viewFile/5543/4571. Accessed 23 Nov 2016

The Department of Forests under the Ministry of Forests and Soil Conservation, with support from WWF Nepal and UNDP, is presently implementing programs such as Tarai Arc Landscape, Western Tarai Landscape Complex Project and are supporting the interventions mentioned above.

### 4.1.15 Natural Resources and Human Livelihoods

Nepal is very rich in natural resources. It is second in the world in terms of water resources and twenty-fifth in biodiversity, with 118 ecosystems, 75 vegetation types and 35 forest types. About 370 identified species of flowering plants are considered endemic to Nepal and about 700 species are known to possess medicinal properties.[141]

The next sub-section of the report, on agro-ecological zones, provides more detail on resources related to human livelihoods. The sub-section on needs and responses that follows discusses the threats to those resources and livelihoods and efforts to overcome the threats.

**Agro-ecological zones**

Nepal is divided into three agro-ecological zones: Mountain, Hills and Tarai (Table 26). This broad division is based on the altitude, crop and livestock production systems.[142]

Table 26. Area of Agro-ecological Zones

| Agro-ecological zone | Area ($km^2$) | Percentage |
|---|---|---|
| Mountain | 51 817 | 35 |
| Hills | 61 345 | 42 |
| Tarai | 34 019 | 23 |
| Total | 147 181 | 100 |

Source: Country Pasture/Forage Resource Profiles, Nepal www.fao.org/ag/agp/agpc/doc/Counprof/Nepal/nepal.htm. Accessed 14 Nov 2016

Livestock are raised from the plains of the Tarai to the rain shadow areas of the Himalayas, and there is a strong integration of crops with livestock, forestry and marketing in all agro-ecological regions. The role of livestock in each agro-ecological zone is specific.

Mountain (> 2,500 masl)

In the high hills or mountain areas people are influenced by Tibetan culture and Thakalis, Sherpas and Bhotias live in separate, single, ethnic settlements. The climate varies from warm temperate to alpine. Livestock production is based primarily on crops and grazing. The cultivation in this agro-ecological zone

[141] FAO. 2000. FRA 2000 - Forest resources of Nepal, country report.

[142] Country Pasture/Forage Resource Profiles, Nepal www.fao.org/ag/agp/agpc/doc/Counprof/Nepal/nepal.htm. Accessed 14 Nov 2016

includes annual crops on rain-fed and irrigated land and perennial crops. Grazing in the zone includes the migration of ruminant livestock and the utilization of vegetation where herds are made up of yaks, chauries (yak-cattle cross breed), cattle, sheep, goats and horses, reared in semi-pastoral or transhumant systems. Livestock move in an annual cycle according to their specific requirements and grazing availability at different altitudes. Yaks occupy an ecological niche at high altitudes (3,000 – 5,000 masl) and chauries move between 1,500 – 4,000 masl, while cattle move between 2,000 and 3,000 masl. Sheep, goats and horses are more adaptable to altitude and move between 1,200 – 4,000 masl. Plant growth is limited by low temperatures and a short growing season. Barley, buckwheat and potato are the major crops. Pasture at high altitudes is only accessible for grazing in summer (July - September) after which herds move to lower areas for winter (December - March); yaks, however, which are adapted to cold conditions, are seldom taken below 2,500 masl.

Livestock provide milk and fiber and their waste is a major source of fuel and compost. Crossbred males are used for transport and meat while goats and sheep supply meat and fiber. The use of mules, sheep and goats for trading and transport of basic inputs (such as grain, salt, and building materials) is an important source of income which is being replaced by mechanized transport.

Hills (500-2,500 masl)

In the mid hills people are more influenced by the predominant Hindu culture. There are 24 groups in the area: Baramu, Bhujel, Chepang, Chhantyal, Dura, Fri, Gurung, Hayu, Hyolmo, Jirel, Kusunda, Lepcha, Limbu, Magar, Newar, Pahari, Rai, Sunuwar, Surel, Tamang, Thami, Kumal, Yakkha and Tin Gaunle Thakali. They live in multi-ethnic settlements. Livestock, although an integral part of agriculture, is secondary to crops. Climate varies from subtropical to warm-temperate and the major cereals are paddy, wheat, maize and finger millet (Eleusine coracana).

Cattle, buffalo and goats are the main grazing livestock and livestock rearing is sedentary and animals make daily grazing forays and return every evening. Foraging include: grazing in the forest, on cultivated land after harvest, and on fallow lands; also, crop residues of paddy, maize, millet, wheat, mustard, soybean and vegetables; grass gathered from terraces and forests; as well as tree fodder gathered from farmer-owned and forest trees.

Tarai (< 500 m)

The Tarai is also characterized by multi-ethnic settlements – such as the Bankaria, Bote, Danuwar, Darai, Majhi, Raji and Raute in the Inner Tarai, and Dhanuk (Rajbanshi), Dhimal, Gangai, Jhangad, Kisan, Kushbadia, Meche, Rajbanshi (Koch), Satar (Santhal), Tajpuria and Tharu in the Tarai. They are predominantly influenced by Hindu culture. Cattle and buffalo are the source of milk, manure and draught. Oxen are used for transport and cultivation.

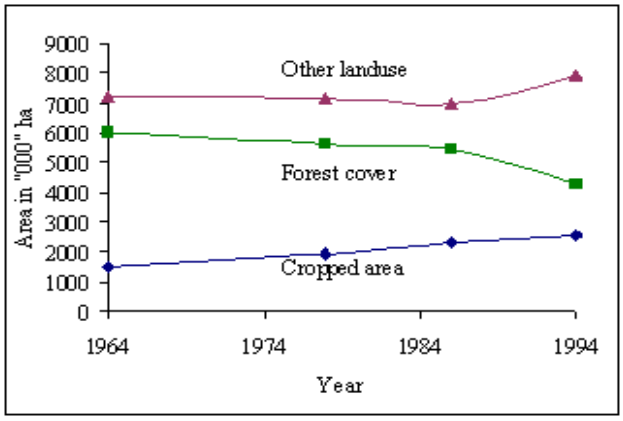
Although chemical fertilizers have become increasingly important for intensive cropping, manure is still the main source of nutrient replenishment and soil fertility maintenance. In many areas where massive deforestation has reduced the supply of firewood, dung is an important fuel, too.[143]

Cattle, buffaloes and goats are the main grazing livestock. The predominant system of livestock rearing is sedentary and animals make daily grazing forays and return every evening. Compared with the mid-hills, there is less grazing land and forest; therefore, more crop residues are fed and thus, the amount of stall-feeding relative to grazing is greater in the Tarai than in the Mid hills.[144]

**Needs and Responses**

The needs of a growing population are adversely affecting the sustainability of its natural resources. Forests play a vital economic, social and environmental role in Nepal, but have deteriorated over time. Forest cover has shrunk from 45% in 1964 to 29% in 1994. Anthropogenic disturbance has threatened the existence of more than 60 species. The diversion of forest land for resettlement, roads, academic institutions and other development activities as well as encroachment, illicit felling and excessive grazing are adversely affecting the extent, productivity, and sustainability of forest resources.[145]

**Figure 26. Trend in Forest and Other Land Use**




Source: FAO, 2000

The forestry sector in Nepal is doing its best to meet its dual responsibility of making an increased contribution to the gross domestic product while conserving bio-physical resources. Many forestry sector programs such as community forestry, lease-hold forestry, pasture development, soil and water

[143] Country Pasture/Forage Resource Profiles, Nepal. www.fao.org/ag/agp/agpc/doc/Counprof/Nepal/nepal.htm. Accessed 14 Nov 2016

[144] Ibid

[145] National Planning Commission. 1998. The Ninth Five-Year Plan (1998–2002)

conservation, conservation of protected areas and development of markets for non-wood forest products are being implemented in selected locations with increased participation of the people. Attempts are being made to extend this participatory mode of management to Protected Areas for biodiversity conservation.

There is a significant divergence in perception of the urban residents and the rural people forest resources. Like other South Asian countries, the urban areas in Nepal are generally distant from the forest and are occupied by people that have a greater set of choices and alternatives and often have little knowledge of or dependency on forest resources than rural people.[146] The rural people value forests more as a source of physical goods for day-to-day consumption than for environmental services. The urban people derive their valuation of forests from macro level environment oriented information sources and accordingly value forests more for environmental services than for physical goods.

The Five-Year Plans developed by the National Planning Commission, Government of Nepal, recognize the complexity of the forestry sector and has called for a holistic approach and a mix of strategies to translate government policies into administrative and managerial actions. The Plans clearly state the goals of the government for sustainable development and scientific utilization of forest resources in accordance with liberal economic policies. Increased level of compatibility between framework of forestry development and that of economic development has increased the potential of sustenance of forest resources in Nepal.

### 4.1.15 Cultural Resources

Cultural site information here and in succeeding subsections of section 4 as a check against the impact evaluations in section 6. It may not be apparent that all known cultural sites have been avoided by the unique application of the LRT and multidisciplinary routing methodology applied by the PESIA team. Each transmission line, substation, and access road will need to be closely examined during the ESIA stage to confirm/deny this finding.

Tangible and moveable or immovable objects, property, sites, structures, or groups of structures, with archaeological, paleontological, historical, cultural, artistic, and religious values as well as unique natural features or objects that epitomize cultural values, and certain instances of intangible forms of culture that are proposed to be used for commercial purposes, such as cultural knowledge, innovations, and practices of communities embodying traditional lifestyles, are considered as cultural resources.[147]

**Archaeological/historical sites of Nepal**

The discovery of an upper left-molar bone of Ramapithecus on the Churia (Siwalik) range, in Tinaukhola near Butwal in western Nepal in 1981 has established Nepal as a country where mankind was present 14 to 8 million years ago.

[146] National Planning Commission. 1998. The Ninth Five-Year Plan (1998–2002)

[147] IFC 2012 Performance Standard 8 Cultural Heritage

Over the past few decades archaeological work in Nepal had focused on the Tarai region of the country where Nepal's first settlements were probably located. Tilaurakot situated in Kapilbastu District in western Nepal, had been the capital of the Shakya Dynasty (c. 1500 - c. 500 BCE) which ruled in North India and Nepal. The present archaeological site extends over the area of more than 5 $km^2$. The central portion, measuring approximately 5000 x 4000 m, is surrounded by a citadel built at three different periods. The first and second ancient citadel walls are made of mud and date from 600 to 200 BCE, while the third wall appears to have been constructed with kiln burnt bricks around 150 BCE. The eastern gate, the eastern stupa, the Ashita Apsidal Stupa and a defense wall were first discovered at the site. More recent excavations have brought to light the majestic western gateway complex including the watchman's room, six-meter wide roads of different periods with cart-track impressions, the moat on the east and west, three periods of defense walls and northern twin stupas made and enlarged between the fourth and second centuries BC. The central portion of the site has also been excavated and various brick structures from the third century BCE to the second century AD have been unearthed. Water storage tanks, big jars, brick and terra-cotta ring wells and a fire-alter have also been found. Other antiquities discovered at the site are human and animal terra-cotta figurines (dated 400 BCE to AD 200), silver punch-marked coins, early cast coins with symbols, Mitra coins with different symbols, Kushan coins, and pieces of Sunga and Kushan pottery. Apart from these antiquities, practical items such as terra-cotta cart wheels, iron implements, nails, arrowheads, bone and copper rods, dice and fishing hooks have also been found.[148]

Lumbini is also one of the four sacred centers of Buddhism, marked by sanctifying inscriptions and the legendary site of the Buddha's birth, which is considered as of utmost importance as a physical cultural resource of the country, is located at Nepal's Pilgrimage Centre, Nepal[149]. By tradition, Lumbini is the garden site where the Buddha's mother, Maya Devi, grasped a tree and gave birth to the historical figure Siddhartha Gautama, who later became the Buddha.

Gotihawa, rich in possession of ancient ruins is situated 11 km south of Tilaurakot and 6 km South West of Taulihawa, the present district headquarters. To the north of Gotihawa village, lies an ancient brick stupa and an Ashokan Pillar. The lower portion, with its square granite base stone, is still intact but the crowning features and inscriptional portions are missing. The site has been identified as the Nirvan Stupa of Kakuchhanda Buddha, one of the previous Buddhas.[150]

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148

http://www.manang.com/nepal/general_information_about_nepal/art_architecture_nepal/archaeology_of_nepal. php. Accessed November 8, 2016

149 Dan Vergano .2013. National Geographic Nov 2013. Oldest Buddhist Shrine Uncovered In Nepal May Push Back the Buddha's Birth Date

150

http://www.manang.com/nepal/general_information_about_nepal/art_architecture_nepal/archaeology_of_nepal. php. Accessed 8/11/2016

**Figure 27. Excavations within the Maya Devi Temple**
Source: National Geographic, November 2013

The Sagarahawa archaeological site is located 2 km north of Tilaurakot of the bank of the Banganga River. In the same general region, sites of ancient civilization have been identified at Lumbini, Banjarhi, Nipaniya and Kadyatawa, to mention just a few.[151]

Several important sites have also been excavated in the eastern region of the country, the most important of which are Bhediari, Varahakshetra, Janakpur and Simaraongad.[152]

Bhediari is located nearly 10 km south of Biratnagar and the ancient ruins at this site include many important brick temples. There is a two-meter high rectangular platform supported from inside by cross walls. So far, no image either of stone or terra cotta has been found during the excavations; however, a number of silver punch-marked coins have been found.[153]

Varahakshetra is another important temple site located at the confluence of the Koka and Koshi rivers. This site is supposed to belong to the period of later Guptas, who had issued a copper grant for the two Varaha images found there. There are also many miniature Gupta period (4-5 century AD) temple replicas at this site, which suggest that many such temples and idols were made during the sixth and seventh centuries AD. Some years ago, an idol of Vishnu was discovered at Narasingha Tappu. This image now protected inside a local Shiva temple belongs to the fifth or sixth century AD and is of the

[151] Ibid
[152] Ibid
[153] Ibid

Gupta tradition. The site, according to local people, also contains pottery items, indicating its connection to the ancient Gupta dynasty.

At Ram-Janaki temple complex near Jankpur an image depicting Uma lying on a bed and feeding a baby has been unearthed. Ganesh and Kumar are also depicted in the panel while on the top of the scene is a Shivalinga. This cultural resource dating back to 12th or 13th century AD belongs to the Karnatakas of Simaraongad.

Simaraongad was an old capital city of the Karnastakas of Mithila and was built by King Nanyadeva in AD 1097-90. The ruins of the city extend over an area of 16 km which is still surrounded by a high wall of kiln-burnt bricks. There are more than one hundred images and sculptures scattered throughout the area. The images at the site are of Vishnu, Narayan, Laxmi Narayan, Shankersana, Garudopari Vishnu, Uma-Maheshwara, Durga, Shiva and Surya. In different parts of Simaraongad there are remains of temples and gateways of the old city. The Karnataka Kshatriyas who ruled between 11th century AD and 14th century AD and invaded Kathmandu made some matrimonial alliances with the rulers of Kathmandu and built innumerable temples and ponds, wells and large numbers of Hindu idols in black schistone.[154] Hundreds of icons, sculpture and part of the city wall still decorate the ruined capital city of Simranogarha which was the seat of these rulers.

Other sites bearing Karnataka images and sculptures are Kanchanpur (Near Rajbiraj), Murtiya (West of Janakpur) and Valmiki Nagar (near the Gandaki barrage), as well as several other places between the Gandaki and Sapta Koshi rivers.

It is not known for certain when Pashupatinath was founded, however, tradition says it was constructed by Pashupreksha of the Somadeva Dynasty in the 3rd century BC, but the first historical records date from the 13th century. By the later Middle Ages, many imitations of the temple had been built, such as in Bhaktapur (1480), Lalitpur (1566) and Benares (early 19th century). The original temple was destroyed several times until it was given its present form under King Bhupalendra Malla in 1697.

**Religious Places**

Hinduism is the majority religion in the state and profoundly influences its social structure, while Buddhism (Tibetan Buddhism) is practiced by some ethnic groups (for example Newar) in forms which are strongly influenced by Hinduism; Kiratism otherwise is the grassroots native religion of populations belonging to the Kirati ethnicity. Islam and Christianity have made inroads and are the religious identity of small populations. Since both Hinduism as well as Buddhism are Dharmic religions, they usually accept each other's practices and many people practice a combination of both and in many places Hindu and Buddhist temples exist in close proximity.

Kathmandu Valley has been recorded in the past as having more temples than private houses. This valley is also considered the treasure house of art and architecture beginning from 2nd to 1st BCE and

[154] Mishra T. N. 2010 The Historical Dynasties and Ancient Archaeological Sites in Nepal

continued to this century.[155] Notable temples in Nepal which have not been listed under archaeological sites above, are Kumari Ghar, Balmaki ashram, Varahakshetra, Devghat, Dhanushadham, Muktinath, Ridi, Gosaikund, Manakamana, Simraungadh**,** Boudhanath Stupa and Swayambhunath Stupa**.**

The principal religions in the Districts affected by the Projects are described in Annex E and will be verified during the field work phase of the ESIA.

## 4.2 General Social and Gender Context

### 4.2.1 Background

**Overview of the Economy**

The complexity of Nepal lies, among other factors, in its history which is steeped in royal struggles, shifting alliances and factionalism, with modern-day Nepal going through several years of severe instability during the Maoist era (1996-2006), seeing dissolution of the monarchy in 2008, and the transition to a new Constitution in 2016. The 2015 earthquake took a tremendous toll on the country, the lingering impact of which has shown up in the slow GDP growth rate, exacerbated by the cross-border trade closure for several months formally lasting from September 2015 to January 2016. Economic growth over the last decade has been low compared with other low-income countries, but is expected to pick up with improved political stability. Nepal's growth is dependent upon services, although subject to volatilities in agricultural output, which is nearly 34% of GDP.

The population of Nepal is just under 29 million people, a fifth of whom are found in growing urban centers. The skewed 1.07 male/female sex ratio at birth places Nepal 11th in the list of countries where son preference and discrimination against girls/women contributes to the use of prenatal sex selection, selective abortion, and female infanticide, resulting in a 'missing women'. According to WHO data published in 2015, life expectancy at birth has increased by 23 years to about 71 years for women and 68 years for men. The multi-ethnic characteristic of Nepal's population is illustrated in Figure 28. . About 80% of Nepal's people live in rural areas and depend on subsistence farming for their livelihoods. Household food insecurity and poor nutrition are major concerns in these areas, where about half of children under five years of age are undernourished. Most rural households have little or no access to primary health care, education, safe drinking water, sanitation or other basic services.

The labor force participation is 80% for women and 87% for men, but the participation of men and women in the labor force is markedly different. Nearly 80% of economically active women are engaged in agriculture and forestry, though they occupy less than half of the total share of waged positions. Women's share of employment in manufacturing is 3.9%, with men's share only slightly larger at nearly 8%. While paid employment is limited for both men and women, women predominate in the informal

[155] Mishra T. N. 2010 The Historical Dynasties and Ancient Archaeological Sites in Nepal

sector; of those employees who are waged, women make up only 7.7% while the figure for men is nearly 25%. The numbers of women in agriculture work is rising as more men migrate out of rural areas for work. Although women's share of total foreign migration is relatively small, it has increased thirtyfold from 0.19% in 2006 to nearly six% in 2012[156]. Women in Nepal lack access to the important resource of time: they comprise three quarters of the unpaid family labor force and have a much higher workload than the global average. Their economic potential is constrained by lack of access to information, productive resources, financial institutions, credit and technology.

Nepal has achieved some of the MDG goals, in particular in gender parity in primary enrolment and maternal health and child immunization, though there are differences by region, caste and ethnicity. Between 1990 and 2015, the country reduced its maternal mortality ratio by 71%– just four percentage points short of MDG 5. These changes resulted in part from health sector investments as well as those made in sectors outside health, such as education and road infrastructure. In 2006, home births accounted for about 81% of all births in Nepal. In 2011 that figure dropped to 63%, according to the Nepal Demographic and Health Survey reports for 2006 and 2011 respectively.[157]

**Poverty and Vulnerability**

Poor rural people in Nepal generally have large families, very small landholdings or none at all, and high rates of illiteracy. They are concentrated in specific ethnic, caste and marginalized groups, of whom some face particular vulnerabilities, including those of the lowest caste (Dalits), indigenous peoples (Janajatis) and women. Population density in the country varies according to altitude – averaging more than 1,000 persons per square kilometer ($km^2$) in the low Tarai region, about 300 persons per $km^2$ in hilly regions and as few as 30 persons per $km^2$ in mountainous areas. Generally, the rural poor in Nepal include destitute people, such as those who are sick, ex-bonded labor, disabled or displaced, and abandoned children; extremely poor people, such as illiterate or landless individuals, and those with very few assets; moderately poor people, such as those who have small farms but are heavily indebted; and the near poor, which includes including small farmers who are at risk of falling back into poverty as a result of factors such as conflict, natural disasters, debt and land degradation. Investments in human and physical capital, fertility, and migration depend on the amount of remittances the household receives.

[156] Government of Nepal, Department of Foreign Employment 2013. *Nepal NGD Progress Report*.

[157] WHO 2016. "Reaching Nepal's mothers in time." *Bulletin of the World Health Organization*; 94:318-319.

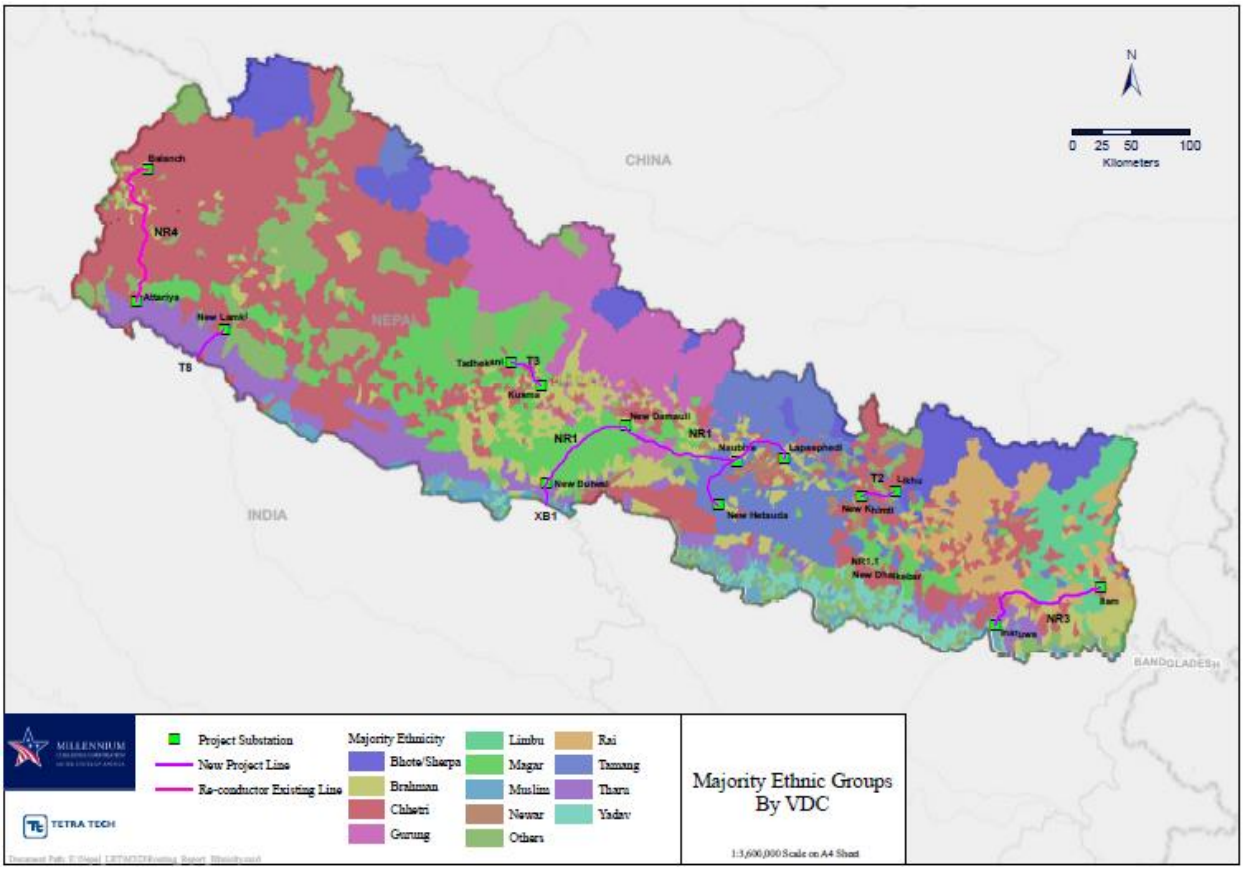


**Figure 28. Ethnic Groups in Nepal**

Despite isolationism, civil instability and recent tumultuous natural disaster, Nepal has shown progress in poverty and human development indicators. The rate of poverty reduction has doubled in the past 5 years compared with the 15-year period 1995-2010, with a current decline in absolute poverty of around 2 percent a year[158]. Non-income based measures of poverty have also improved, with gains in health, education and access to basic services. The estimated population living below the income poverty line in purchasing power parity ($1.21/day) terms is estimated at 24%.

However, Nepal remains one of the poorest countries in the world. Nepal's HDI value for 2014 is 0.548—in the low human development category—positioning it at 145 out of 188 countries and territories. Between 1980 and 2014, Nepal's HDI value increased from 0.279 to 0.548, an increase of 96.2% or an average annual increase of about 2.0%.

Over 30% of Nepalese live on less than US$14 per person, per month, according to the national living standards survey conducted in 2010-2011. While the overall poverty rate for Nepal is 25%, this figure

[158] World Bank. Moving Up the Ladder: Poverty Reduction and Social Mobility in Nepal. 2016. Page 18

increases to 45% in the Mid-Western region and 46% in the Far-Western region. In these remote hill and mountain zones, the terrain is rugged, rainfall is low and the poor-quality soil is difficult to farm. Agricultural holdings per household are the smallest in the country.

Table 27. Poverty Rates and Pace of Poverty Reduction in Nepal

| Survey Year | 1995/96 Poverty Line | 2010/2011 Poverty Line | Official Poverty Estimate 2010/11 |
|---|---|---|---|
| | Poverty Headcount Rate (% of Population) | | |
| 1995-96 | 41.8% | 63.8% | |
| 2003-04 | 30.8% | 49.4% | |
| 2010-11 | 12.5% | 30.8% | 25.2% |
| Period | Pace of Poverty Reduction (annual percentage point change) | | |
| 95/96-03/04 | 1.36% | 1.80% | |
| 03/03-10/11 | 2.62% | 2.66% | |
| 95/96-10/11 | 1.96% | 2.20% | |

Source: World Bank. Nepal Strides Bigger in Post-Conflict Poverty Reduction Diagnostics, 2010-11. 2013. Cited in Moving Up the Ladder: Poverty Reduction and Social Mobility in Nepal. 2016. Page 18.

There are significant variations in the poverty profile across Nepal. Chronic poverty[159] is dominant over transient poverty and has long-term impacts on household welfare, especially in the intergenerational transmission of poverty. The Mid and Far West (M&FW) regions of the country have significantly higher levels of chronic poverty, as a recent index— comprising indicators on severity, health and nutrition, basic services and standard of living, women's empowerment and gender disparity and remoteness, as shown in Figure 29 . The M&FW region not only has the highest proportion of poor, but the extent of poverty is also higher than in other regions. Even within the M&FW regions, significant zonal and district level differences exist in the extent of chronic poverty and vulnerability, with Kailali having the highest at 70%, followed by Seti at 49%.

[159] Defined as covering the first two categories of the following: (i) **Always Poor** refers to those whose poverty score (income, consumption, nutritional status, human deprivation index, etc.) in each period is below a defined poverty line; (ii) **Usually Poor** refers to those whose mean poverty score over all periods is less than the poverty line but are not poor in every period; (iii) **Churning Poor** refers to those with a mean poverty score around the poverty line but who are poor in some periods but not in others; (iv) **Occasionally Poor** refers to those whose mean poverty score is above the poverty line but have experienced at least one period in poverty; and (v) **Never Poor** refers to those with poverty scores in all periods above the poverty line. David Hulme, Karen Moore and Andrew Shepherd. *Chronic Poverty: Meanings and Analytical Frameworks*. Chronic Poverty Research Centre. University of Manchester. 2001. See also various papers in *World Development Report*, Volume 31, March 2003; and P. Khanal, "The Nature of Chronic and Transient Poverty: Analyzing Poverty Dynamics in Nepal," *Economic Journal of Development Issues,* Vols. 15-16, No. 2, 2013.

A recent report[160] also notes that: "Food-poverty was highest in the Far-West (39.5%), while non-food poverty alone was highest in the Mid-West (46.5%). Adult illiteracy was between 5% and 10% higher in the M&FW regions … Childhood stunting and underweight was about 5% higher in the M&FW, while wasting was highest in the Central region. The prevalence of maternal anaemia … was highest in the M&FW and lowest in the Eastern region (difference of about 10%). Standard of living was generally worse in the M&FW regions with, for example, about 75% of households not having electricity compared with 67% in the Eastern region and under 45% in Central and Western regions. Gender inequality was generally worse in the M&FW regions; women in the M&FW were twice as likely to be illiterate than women living in the Western region … The gender-related development index was generally worse for females in these two regions and fewer M&FW women were employed in professional or administrative positions. Households in the M&FW regions tended to be more remote and about 50% lived more than 60 minutes away from a health center compared with 30% to 40% in other regions."

The same report provides insight into the variations in chronic poverty and vulnerability indicators across the regions (Table 28).

The dimensions of poverty are many and diverse, especially in the complex socioeconomic structure of Nepal. The analysis of poverty by caste and ethnicity is a substantive area that will be covered in more detail during the conduct of the final ESIA.

[160] UK DFID 2013. Background Report 3: Description of the geographic and social distribution of chronic poverty and vulnerability in the Mid- and Far-West regions vis-à-vis other regions. In Regional Dimensions of Poverty and Vulnerability in Nepal: Background Reports.


**Figure 29 Chronic Poverty Composite Index Dimension (%) by Region**
DFID 2013. Regional Dimensions of Poverty and Vulnerability in Nepal: Summary.

Table 28. Chronic Poverty and Vulnerability: Variation in Indicators by Region

| | Dimension | Indicator | Eastern | Central | Western | Mid-West | Far West | Total |
|---|---|---|---|---|---|---|---|---|
| **CHRONIC POVERTY** | Severity | Poverty (cost of basic needs method) Total (%) | 41.9 | 32.9 | 32.6 | 57.1 | 52.9 | 39.0 |
| | | Poverty (calorie method) Total (%) | 39.2 | 40.7 | 39.5 | 49.3 | 46.2 | 42.5 |
| | | Poverty – food poor (%) | 24.9 | 24.5 | 16.0 | 34.5 | 39.5 | 25.1 |
| | | Poverty – non-food poor (%) | 34.1 | 21.7 | 28.6 | 46.5 | 35.1 | 29.8 |
| | | Income male | 0.46 | 0.49 | 0.47 | o.41 | 0.41 | 0.45 |
| | | Income female | 0.33 | 0.35 | 0.38 | 0.33 | 0.35 | 0.35 |
| | | Adult illiteracy (%) | 49.7 | 52.3 | 47.1 | 57.5 | 58.3 | 51.4 |
| | | Remittances | 14.6 | 11.1 | 9.6 | 13.4 | 9.8 | 11.8 |
| | | Population Growth (2001- | 43.64 | 51.06 | 44.44 | 47.35 | 51.53 | 47.60 |

Table 28. Chronic Poverty and Vulnerability: Variation in Indicators by Region

| | Dimension | Indicator | Eastern | Central | Western | Mid-West | Far West | Total |
|---|---|---|---|---|---|---|---|---|
| | | 2021) | | | | | | |
| | | Population density | 228 | 5.28 | 192 | 96 | 117 | 257 |
| | Health | Child mortality – all (%) | 17.8 | 23.0 | 20.2 | 28.4 | 26.8 | 22.8 |
| | | Child immunization – no (%) | 2.7 | 6.3 | 4.1 | 9.6 | 4.7 | 5.4 |
| | Nutrition | Child stunting (%) | 52.1 | 53.3 | 53.6 | 60.3 | 58.1 | 55.1 |
| | | Child underweight (%) | 42.6 | 44.2 | 41.4 | 50.5 | 50.5 | 45.3 |
| | | Child wasting (%) | 7.2 | 8.7 | 6.8 | 7.6 | 8.2 | 7.7 |
| | | Material BMI <18.5 (%) | 21.5 | 23.7 | 19.4 | 24.0 | 30.1 | 23.4 |
| | | Material hemoglobin – anemia (%) | 29.3 | 34.6 | 33.0 | 39.5 | 42.0 | 35.0 |
| | Access to basic public services | Health institutions/1000 population | 2.8 | 3.1 | 3.0 | 2.1 | 2.2 | 2.7 |
| | | Access to basic services | 3.5 | 3.4 | 3.4 | 3.0 | 3.1 | 3.3 |
| | Standard of Living | Electricity (%) | 66.7 | 43.8 | 44.9 | 74.8 | 79.7 | 55.4 |
| | | Drinking water not MDG (%) | 16.7 | 14.5 | 12.6 | 35.7 | 24.3 | 17.8 |
| | | Drinking water not MDG >30 minutes (%) | 17.0 | 15.2 | 13.6 | 37.1 | 27.5 | 18.7 |
| | | Sanitation not MDG (%) | 57.2 | 49.5 | 43.6 | 72.6 | 75.4 | 54.6 |
| | | Floor construction – poor (%) | 77.8 | 66.9 | 68.5 | 84.9 | 87.3 | 73.3 |
| | | Wall construction – poor (%) | 29.7 | 39.8 | 58.6 | 71.1 | 59.1 | 46.2 |
| | | Roof construction – poor (%) | 51.1 | 18.2 | 21.4 | 52.0 | 12.3 | 29.9 |
| | | Cooking – poor | 91.3 | 66.6 | 79.3 | 91.1 | 94.3 | 79.6 |

Table 28. Chronic Poverty and Vulnerability: Variation in Indicators by Region

| | Dimension | Indicator | Eastern | Central | Western | Mid-West | Far West | Total |
|---|---|---|---|---|---|---|---|---|
| | | (%) | | | | | | |
| | | Assets – none (%) | 30.6 | 21.4 | 23.5 | 22.4 | 35.1 | 25.0 |
| | Women's empowerment and gender disparity | Literacy status female (%) | 34.9 | 32.2 | 40.0 | 20.5 | 19.3 | 30.5 |
| | | Years of schooling – female (years) | 2.1 | 1.8 | 2.2 | 1.1 | 1.0 | 1.7 |
| | | Female-headed households (%) | 17.3 | 15.7 | 28.7 | 20.0 | 20.8 | 19.6 |
| | | Women participation in local elections | 19.4 | 19.2 | 21.7 | 18.6 | 19.7 | 19.7 |
| | | Women in professional occupations | 16.8 | 16.3 | 19.2 | 15.3 | 12.4 | 16.3 |
| | | Women in administrative occupations | 12.1 | 10.1 | 13.3 | 8.9 | 7.4 | 10.6 |
| | | Gender-related development index | 0.447 | 0.415 | 0.464 | 0.331 | 0.318 | 0.417 |
| | Remoteness | Remoteness health post >60 minutes (%) | 33.7 | 27.2 | 39.7 | 48.2 | 53.6 | 35.5 |
| | | Remoteness road head >60 minutes (%) | 29.3 | 7.9 | 19.6 | 39.3 | 33.7 | 20.7 |
| | | Remoteness market >60 minutes (%) | 48.0 | 33.9 | 36.8 | 52.9 | 52.9 | 41.3 |
| **VULNERABILITY** | Natural disasters | Landslide | 2.44 | 2.74 | 2.89 | 3.2- | 3.00 | 2.83 |
| | | Drought | 2.25 | 2.74 | 2.06 | 3.73 | 3.56 | 2.78 |
| | | Earthquake (mean magnitude) | 3.36 | 2.16 | 1.88 | 2.41 | 2.60 | 2.46 |
| | | Flooding | 1.81 | 2.11 | 1.25 | 1.20 | 1.44 | 1.60 |
| | | Climate vulnerability index | 3.12 | 3.53 | 2.75 | 3.13 | 2.89 | 3.12 |
| | Risk and exposure | Child (<5 years) | 455 | 401 | 326 | 375 | 376 | 387 |

Table 28. Chronic Poverty and Vulnerability: Variation in Indicators by Region

| | Dimension | Indicator | Eastern | Central | Western | Mid-West | Far West | Total |
|---|---|---|---|---|---|---|---|---|
| | to health hazard | ARI/1000 population | | | | | | |
| | | Child (<5 years) Diarrhea/1000 population | 221 | 193 | 165 | 247 | 216 | 206 |
| | | Malaria/1000 population | 0.82 | 0.10 | 0.08 | 0.12 | 0.22 | 0.27 |
| | | Tuberculosis/1000 population | 0.18 | 0.29 | 0.17 | 0.12 | 0.15 | 0.19 |
| | | HIV hotspots | 12.1 | 17.8 | 2.3 | 96.2 | 61.6 | 34.2 |
| | | Caste – Dalit (%) | 9.6 | 8.3 | 14.6 | 16.2 | 16.9 | 12.5 |
| | | Rural (%) | 96.6 | 88.6 | 98.4 | 98.4 | 99.6 | 94.4 |
| | | Dependency ration (%) | 83.3 | 89.9 | 93.2 | 89.2 | 96.5 | 89.2 |
| | Resilience (coping) | Loans (%) | 73.4 | 60.8 | 65.5 | 61.0 | 63.8 | 64.9 |
| | | Migrants – from abroad (%) | 16.7 | 11.6 | 16.8 | 14.3 | 10.9 | |
| | Food insecurity | Agricultural land (persons per hectare) | 7.4 | 16.7 | 11.8 | 9.4 | 11.5 | 11.6 |
| | | Area of irrigated land (%) | 38.1 | 42.5 | 36.6 | 30.6 | 38.0 | 37.4 |
| | | Food insecurity summer | 1.57 | 2.07 | 1.43 | 2.82 | 2.79 | 2.06 |
| | | Food insecurity winter | 1.67 | 1.85 | 1.44 | 2.37 | 2.36 | 1.89 |

Source: DFID 2013. Regional Dimensions of Poverty and Vulnerability in Nepal. Background Reports. Page 32.

A large proportion of the Nepali productive workforce lives overseas, with resulting dependence on volatile external remittances, currently estimated at $8 billion (with informal sector remittance, that estimate may be as high as $12 billion). Aside from the estimated half-million working in Asia and the Middle East, some 1.5 million regularly cross into India for permit-free work in India. In 2001, one in ten households had a member living abroad, and a decade later, the rate was one in four. Nepali labor migrants have obtained permits to work in as many as 142 countries during 2008/09–2014/15. Any country that is a member of the United Nations, unless banned by the Government of Nepal, may be

chosen by a migrant worker as destination country, although the Government limits the number of countries that may be managed for employment through recruitment agencies.[161]

Remittances from expatriates grew at 30% per year and from less than 3% of GDP in 1995 to about 15% by the end of 2003, and now just about 30% of the country's GDP, with over 50% of households receiving remittances. With current decline in demand across the Middle East and Malaysia, the overseas workforce is diminishing, but still represents a significant source of support for services and financing of imports. Work migration and remittances, along with the higher agricultural growth, are usually considered the key factors behind declining poverty in Nepal since 1996, with an obvious distributional implication that affects the overall rate of growth as migration levels are higher in some parts of the country than others.

**The Earthquake and its Aftermath**

The devastating earthquake measuring 7.8 on the Richter scale that struck the country in April and May 2015, and its frequent aftershocks, caused a devastating loss of life and property. About 8,700 people died, half a million homes were lost, and about eight million people were affected in some way. Many government and public office buildings, historical, cultural and archeological heritages were destroyed, including schools, bridges, medical facilities and roads. The Government declared fourteen districts as crisis-hit districts. A reconstruction and rehabilitation fund was established, initially with some $200 million.

The effects of the earthquake did not only vary by physical proximity to the disaster, but also by gender—a phenomenon not unique to Nepal. A 2007 study[162] found that between 1981 and 2002, natural disasters in 141 countries killed significantly more women than men, and that the worse the disaster, the bigger the gender disparity. This difference occurs for various reasons: more women may be in the home than men or unable to perform certain acts, such as swimming or climbing trees, to save themselves. Sanitation issues resulting from natural disasters affect women differently and their lack of voice in financial and political decision making can marginalize their needs on an assistance and rehabilitation agenda. Women-headed households are at particular risk.

UN Women[163] estimates that the 13 most affected districts in Nepal[164] include about 318,000 female-headed households, 38,000 women with disabilities, 157,000 women over 65 years, 738,000 girls 14 and under, and 765,000 illiterate girls and women.

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[161] See Government of Nepal. *Labor Migration for Employment A Status Report for Nepal: 2014/2015*.

[162] E. Neumayer and T. Plümper. 2007 "The Gendered Nature of Natural Disasters: The Impact of Catastrophic Events on the Gender Gap in Life Expectancy, 1981–2002.". *Annals of the Association of American Geographers*. 97:3, 551-566.

[163] UN Women. *Nepal Gender Profile 2015*.

[164] Bhaktapur, Dhading, Dolakha, Gorkha, Kavrepalanchwok, Kathmandu, Lalitpur, Nuwawakot, Ramechhap, Rasuwa, Sindhupalchwok, Makawanpur, Sindhuli

**Caste and Ethnicity**

Nepal is a complex interplay of castes and ethnic minorities. Hinduism, which is the religion for over 80% of Nepali citizens, traditionally sets out a hierarchal system, which categorizes people into caste groups according to a division of labor, roles, and functions. It is estimated that there are about 125 castes and ethnicities that contribute to the "mosaic" that is Nepali society. In Nepal, the "upper" castes include the Brahmins and Chhetris, and the "lower" castes refer to Dalits who suffer from caste- and untouchability-based practice and religious, social, economic, political, and cultural discrimination. Aside from caste, Nepal has the Adivasi Janajatis, who have distinct languages and traditions—some 59 groups of indigenous peoples. Finally, the Madhesis are identified by those who use the Maithili, Bhojpuri, Awadhi, Urdu, and Hindi languages as mother tongues. Social exclusion relates to both regional and cultural identity in the case of Janajatis and Madhesis. Table 29, Table 30, and Figure 30 below show the structure and diversity of principal castes and ethnicities in Nepal.

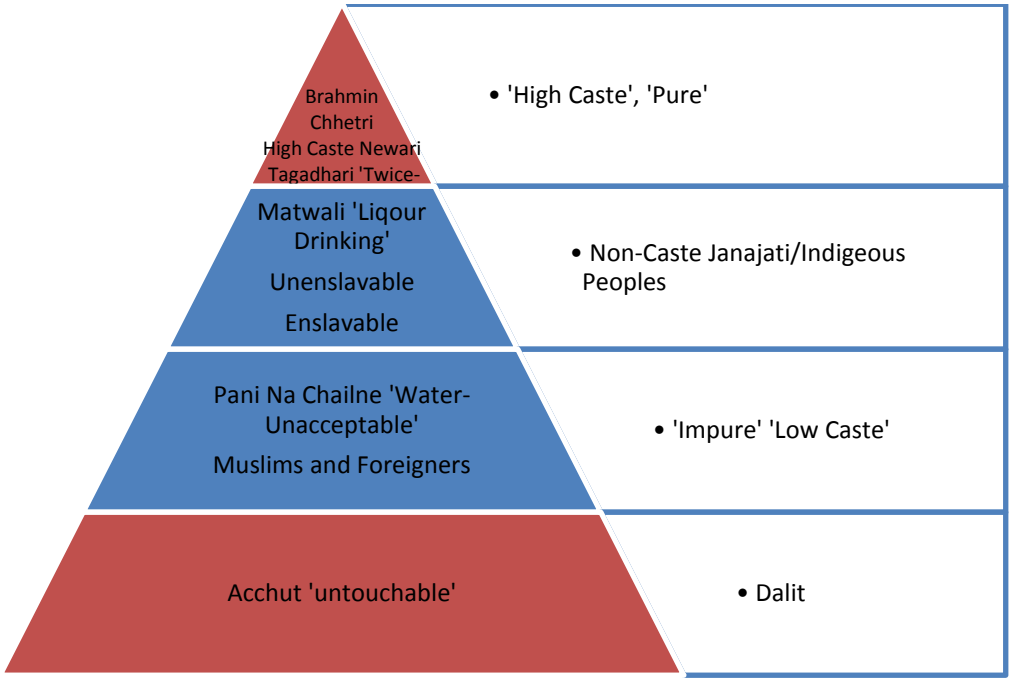


**Figure 30. Nepal Caste Pyramid According to the Muluki Ain 1854**

World Bank. Unequal Citizens: Gender, Caste and Ethnic Exclusion in Nepal. 2011.

The Muluki Ain of 1854, which was the first of the available written laws of Nepal, recognized and legalized the caste-based social hierarchy of Hinduism. This codification of a system made social mobility virtually impossible and ingrained discrimination into economic and socio-legal processes. Muluki Ain incorporated castes and ethnic groups, which is totally unique to the Nepal experience. In 1963, it was replaced by the Country Code abolishing all forms of discrimination and untouchability and recognizing customary mores and practices of certain indigenous communities. Figure 30 illustrates the system established by the Law, whose legacy continues to impact upon social norms and processes.

However, discrimination has continued and social stigmas are still apparent, especially in rural areas. Five traditionally excluded groups represent 40% of the population (Maggars, Tharu, Tamangs, Muslims, and Dalits).

Table 29. Caste and Ethnic Groups by Type

| | Type | Ethnicity/Caste |
|---|---|---|
| A | Mountain Ethnic | Byansi/Sauka, Himali (Bhote), Sherpa, Thakali, Walung |
| B | Hill Ethnic | Baramu/Brahmu, Bhujel/Gharti, Chepang/Praja, Chhantel, Dura, Gurung, Hayu, Hyolmo, Jirel, Kusunda, Lepcha/Lepche, Limbu, Magar, Newar, Pahari, Rai, Sunuwar, Tamang, Thami, Yakha |
| C | Inner Tarai Ethnic | Bote, Danuwar, Darai, Kumal, Majhi, Raji, Raute |
| D | Tarai Ethnic | Dhimal, Gangai, Jhangad/Dhangad, Kisan, Koche, Meche, Munda, Kuswadiya, Rajbansi, Santhal/Satar, Tajpuriya, Tharu |
| E | Hill Upper Caste | Bahun, Chhetri, Sanyasi, Thakuri |
| F | Hill Dalit | Badi, Damai/Dholi, Gaine, Kami, Sarki |
| G | Tarai Upper Caste | Badhae, Baniya, Barae, Bhediyar/Gaderi, Bin/Binda, Brahmin (Tarai), Dhunia, Hajam/Thakur, Haluwai, Kahar, Kalwar, Kamar, Kanu, Kayastha, Kewat, Koiri, Kumhar, Kurmi, Lodha, Lohar, Mali, Mallah, Nuniya, Nurang, Rajbhar, Rajput, Sonar, Sudhi, Teli, Yadav |
| H | Tarai Dalit | Bantar, Chamar/Harijan/Ram, Chidimar, Dhanuk, Dhobi, Dom, Dusadh/Pasi/Paswan, Halkhor, Khatwe, Musahar, Tatma |
| I | Others | Bengali, Churaute, Jaine, Marwari, Muslim, Sikh |
| J | Unspecified | Adivasi/Janajati, Dalit |

National Foundation for Development of Indigenous Nationalities (NFDIN). *2006 Nepal Atlas of Ethnic and Caste Groups.* Cited in Rimal, G.N. *Infused Ethnicities: Nepal's Interlaced and Indivisible Social Mosaic,* Institute for Social and Environmental Transition-Nepal, Kathmandu, 2011

Table 30. Caste/Ethnic Groupings

| % Total Population | GSEA/NLSS II (10 Groups) | 2001 Census (103 Groups) |
|---|---|---|
| Hindu Caste Groups (57.5%) | 1. Brahmin/Chhetri (Hill) | Brahmin, Chhetri, Thakuri, Sanyasi |
| | 2. Brahmin/Chhetri (Tarai) | Kayastha, Rajput, Baniya, Jaine, Nurang, Bengali |
| | 3. Tarai Middle Castes | Yadav, Teli, Kalwar, Sudi, Sonar, Lohar, Koiri, Kurmi, Kanu, Haluwai, Hajam/Thakur, Badhe, Rajbhar, Kewat Mallah, Numhar, Kahar, Lodha, Bing/Banda, Bhediyar, Mali, Kamar Dhunia |

Table 30. Caste/Ethnic Groupings

| % Total Population | GSEA/NLSS II (10 Groups) | 2001 Census (103 Groups) |
|---|---|---|
| | 4. Dalits (Hill) | Kami, Damai, Sarki, Gaine, Badi |
| | 5. Dalits (Tarai) | Chamar, Musahar, Tatma, Bantar, Dhusadadh/Paswan, Khatway, Dom, Chidimar, Dhobi, Halkhor, Unidentified Dalit |
| Janajatis (37.2%) | 6. Newar | All Newari Castes |
| | 7. Janajatis (Hill) | Magar, Tamang, Rai, Gurung, Limbu, Sherpa, Bhote, Walung, Buansi, Hyolmo, Gharti/Bhujel, Kumal, Sunuwar, Baramu, Pahari, Adivasi Janajati, Yakkha, Shantal, Jirel, Darai, Dura, Majhi, Dunuwar, Thami, Lepcha, Chepang, Bote, Raji, Hayu, Raute, Kasunda |
| | 8. Janajatis (Tarai) | Tharu, Dhanuk, Rajbanshi, Tajpuriya, Gangai, Dhimal, Meche, Kisan, Munda, Santhal/Satar/Dhangad/Jhangad, Koche, Pattarkatta/Kusbadiya |
| Muslims (4.3%) | 9. Muslims | Muslims, Churoute |
| Others (1%) | 10. Others | |

World Bank. *Unequal Citizens: Gender, Caste and Ethnic Exclusion in Nepal*. 2011. Although not updated, table shows relative proportions that are currently similar.

Note: GSEA – Gender and Social Exclusion Assessment; NLSS II – Second Nepal Living Standard Survey (2003-4)

With growing social and economic mobility, the Pyramid does not entirely reflect the current understanding of the caste structure. Poor Dalits continue to face significant social and economic discrimination, but those who have achieved financial, economic and professional success, especially in the urban sector, are generally not regarded as untouchables. Emerging urban youth tend to see their impediments in terms of economic empowerment. However, in the rural environment, caste and ethnicity remain the basis for continuing violence and discrimination against Dalits.

**HIV/AIDS**[165]

HIV/AIDS is a major public health concern in Nepal since the first case was reported in 1988. Currently, Nepal has a heightened indicator, from "low prevalence" to "concentrated epidemic." With the HIV/AIDS prevalence among the adult population (15-49) estimated at 0.20%, the HIV/AIDS prevalence among the adults has not changed much, and has remained within the range of 0.2 - 0.3% in Nepal. It is estimated that currently there were around 39,250 people living with HIV/AIDS in 2014, decreasing from some 40,700 in 2013. Just over 2,500 deaths were due to AIDS in 2014, declining from about 3,400 deaths in 2013. The number of estimated deaths is projected to decline to about 1,300 in 2020, due to an expected increase in the numbers of people on antiretroviral therapy. The estimated number of new cases in 2014 is about 1,500 compared with about 1,400 in 2013. The HIV/AIDS epidemic remains concentrated among people who inject drugs, men who have sex with men, transgender people, sex workers (male and female) and male labor migrants, including their spouses.

A few statistics[166]:

- Percentage of Female Sex Workers living with HIV /AIDS (Kathmandu): 2% (4% street based, and 0.7% settlement-based)
- Percentage of men who have sex with men living with HIV/AIDS: 2.4%
- Percentage of men who have sex with women living with HIV/AIDS: 5.6%
- Percentage of injecting drug users living with HIV/AIDS: 8.3% (East), 2.8% (Pokhara) & 6.4% (Kathmandu)
- Percentage of Male Labor Migrants who are living with HIV/AIDS: 2.4%
- People reported cases of HIV-positive: 26,702 (as of mid-July 2015)
- People receiving antiretroviral therapy: 11,089 (as of mid-July 2015)
- Estimated number of people who do not know their HIV status: 12,547.

The highest burden of people living with HIV/AIDS is estimated seasonal labor migrants (41%), with evidence showing that 27% of Nepali migrants who work in India were engaged in high risk sexual behavior, and frequently visited sex workers. The distribution of HIV prevalence across the country shows that almost 50% of all HIV infection lies in the east-west terrain highway epidemic region, followed by the hill region at 19%, and far western and Kathmandu valley at 16% each, respectively. With the over one hundred ethnic and caste groups, socio-cultural norms provide a formidable challenge to efforts to mitigate the impact of HIV/AIDS.

[165] Drawn from National Centre for AIDS and STD Control (NCASC), *Country Progress Report 2015*; and NCASC Fast Fact Sheet 2016. See also UNAIDS/NCASC, *The HIV/AIDS/STD Situation and the National Response in Nepal*, 2004; and S.P. Wasti et al., "Issues and Challenges of HIV/AIDS Prevention and Treatment Programme in Nepal," *Global Journal of Health science*, October 2009.

[166] Ibid.

**Child and Forced Labor**[167]

Although there have been several surveys to determine the number of working children in Nepal, estimates vary and are difficult to compare due to the use of different definitions of "work" and "labor," and the indicators they use. An ILO report estimates that out of a total child population of 7.77 million aged 5 to 17 years, about 3.14 million are economically active, of which 36,000 are unemployed jobseekers. It is estimated that 1.60 million children in the 5-17-year age group fall into the category of child labor, i.e. about 50.9% of all working children and 20.6% of the total child population. Of those, 0.91 million are girls and 0.69 million are boys, with the overwhelming proportion of child labor, involving over 1.5 million children, found in rural areas; by age group, the distribution is 24.7% (395,000) in the 5-9-year age group,51.3% (821,000) in the 10 -13-year age group and 24.0% (383,000) in the 14-17-year age group.

Across Nepal, children contribute to both simple and demanding household activities from as young as five years of age, to the detriment of their education and health. Their contribution increases in times of financial hardship. Non-household labor activities, especially in the informal sector, expose children to great danger. Chemical, physical, biological and psychological hazards are often present and cause irreversible damage to children's development. Another risk for child workers, particularly girls, is sexual abuse, with young girls targeted by male co-workers and management staff.

In rural areas, children work with their parents or outside their household in agriculture, animal husbandry, manual labor (pottery, iron smithing, basket making, shoemaking, sewing, etc.), and in construction work. Girls are often expected to look after their siblings and prepare for brothers to go to school. In urban areas children, who are predominantly from rural areas, can be found working as domestic workers; in industries (carpet weaving, embroidery in the garment/textiles industry, brick kilns, stone quarries and mines); as porters in the tourism industry or at markets and bus parks; in restaurants as waiters, helpers, cooks, dancers, and prostitutes; as beggars, rag pickers, and vendors on the streets; and in the transportation sector as ticket collectors and as drivers. Due to the open border with India, children from Nepal are also vulnerable to trafficking and can end up working as sex workers, in circuses, carpet, embroidery, garment and bidi industries, road construction, and domestic workers in India. The largest proportion of working children are found in the domestic sector, with porting the second largest sector, the carpet sector, rag picking, and mining.

Although the practice of bonded labor was abolished in Nepal in 2000, there are still former *kamaiyas* (boys in bonded labor) and *kamalaris* (girls in bonded labor) seeking resettlement, education and a decent livelihood. The bonded labor system prevailed in mid-western Tarai where young girls and boys from the Tharu community were engaged in farming, domestic work and animal herding. *Kamalaris* are not only victims of slavery, but also susceptible to sexual abuse. In five districts of the western region,

[167] This section is drawn from the following: ILO 2011, *Child Labor Report*; A. de Groote 2010, *Child Labor in Kathmandu*, Institute for Research on Working Children; UN, *State of the World's Children 2016*; and US Department of Labor 2014, Bureau of International Labor Affairs, *Child and Forced Labor Report- Nepal*. See also, National Planning Commission, *Approach Paper to the Thirteenth Plan (2013/14-2015/16)*, Section 3.3.6.4.

the number there are an estimated 116,000 such cases.[168] In addition, there are also girls affected by the Badi and Deuki system, currently demanding citizenship in their mother's name.

In line with its continuing efforts to address the child labor problem, Nepal ratified the UN Convention on the Rights of the Child, 1989, the Optional Protocol to the Convention on the Rights of the Child on the Sale of Children, Child Prostitution, and Child Pornography, the Forced Labor Convention, 1930, No. 29, ILO Convention 138 on Minimum Wage, 1976, and ILO Convention 182 Concerning the Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labor, 1999. National policies include the National Action Plan for Children (20045-2014/5), National Master Plan on Child Labor (2004-14), School Sector Reform Plan (2009-2015), National Planning Commission Interim Three-Year Plan (2013/14-2015/16), and National Plan of Action Against Trafficking in Persons (2011-2016). The Child Labor (Prohibition and Regularization) Act prohibits children below 16 years from employment in risky occupations, including, among others, public transportation, construction, tourism-related activities, and carpet, cigarette, and cement industries.

**Trafficking in Persons (TIP)**[169]

Nepal is a Tier 2 source, transit, and destination country for men, women, and children subjected to forced labor and sex trafficking in Nepal, India, the Middle East, Asia, and sub-Saharan Africa and to forced labor in Nepal, India, the Middle East, Asia, and the United States in construction, factories, mines, domestic work, begging, and the adult entertainment industry. Unregistered migrants—including the large number of Nepalese who travel through India or rely on unregistered recruiting agents—are particularly vulnerable to forced labor. Some migrants from Bangladesh and possibly other countries transit Nepal *en route* to employment in the Middle East. While recent and reliable statistical data on the number of trafficking cases in and from Nepal are not available, it is estimated that around 11,000 – 13,000 girls and woman work in the night entertainment industry in the Kathmandu Valley alone. It is also estimated that 12,000 – 20,000 women and children fall victim to trans-border human trafficking every year, with around 30% ending up in conditions of forced labor and 70% being exploited as sex workers.

As TIP is a concern throughout Nepal, and the lines run across much of the country, there is no particular correlation between TIP and specific line (and substation) locations. Construction camps may create conditions in which women are sexually exploited, but that is where close monitoring of contractual obligations regarding social behavior will be required.

The PESIA proposes the inclusion of mandatory contract clauses that will require training, outreach and advocacy sessions during the construction period. The final ESIA will map the organizations working in each area on TIP and child labor and be informed by them. Interviews during field visits suggest that

[168] http://www.omct.org/files/interdisciplinary-study/ii_b_3_nepal_case_study.pdf

[169] US Department of State *2015*, *Trafficking in Persons Report*. Government of Nepal 2013 *Report on Anti-Human Trafficking Initiatives*. See also M. Brülisauer 2015, *Human Trafficking in Post-Earthquake Nepal*.

certain elements (primarily the presence of foreign workers) presents a risk, so the issue is less a geographical one than a contextual one.

The 2015 earthquake saw an escalation in trafficking. With almost half a million people having lost their homes, and thousands more left vulnerable, together with the breakdown of protective family-based social structures, the opportunities for trafficking increased dramatically with promises of food, shelter, and protection for those left susceptible. Maiti Nepal, one of the most prominent NGOs dedicated to anti-trafficking, reported an increase in trafficking by around 200-300 cases in the three months after the earthquake compared with the three months before the Disaster, an increase of 20-30%.

In addition to its women and child protection laws and regulations, Nepal is also a signatory to Convention for the Suppression of the Traffic in Persons and of the Exploitation of the Prostitution of Others, 1949 (ratified December 1995); South Asian Association for Regional Cooperation (SAARC) Convention on Preventing and Combating Trafficking in Women and Children for Prostitution, 2002 (ratified September 2006); and UN Convention against Transnational Organized Crime, 2003 (ratified December 2011). However, Nepal has not yet acceded to the UN TIP Protocol.

The 2007 Human Trafficking and Transportation (Control) Act and subsequent regulations prohibits slavery, bonded labor, forced prostitution, facilitation of prostitution and the removal of human organs. However, while the Act criminalizes exploitation, it does not address the process of recruiting, transporting, harboring and receiving victims of trafficking, nor does it recognize child prostitution as trafficking in the absence of coercion, fraud or force, although this has been defined as a form of trafficking by the 2000 UNODC Protocol to Prevent, Suppress and Punish Trafficking in Persons. Other national policies also include the Foreign Employment Act 2007 and the Foreign Employment Policy 2012. The GoN has imposed a ban on migration of females under age 30 to the Gulf States for domestic work.

**Community Forest Participation**

Forests, essential to serve Nepal's agriculture needs, are crucial for everyone. Practices of exclusion, for example of women, the poorest, and those in lower castes in Nepal have called for a focus on the question of genuine participation in CFUG management and forest use by various groups—a topic that has become increasingly well researched.

Women are primary users of forests and main gatherers of forest products. They play an important role in forest protection and are aware of the adverse effects of forest destruction and its dire impact on their lives. Their involvement in the management of CFUGs is beneficial. Studies[170] have assessed how

[170] Agarwal, B. 2009. Gender and Forest Conservation. In: *Ecological Economics*, 68: 2785–99.
Agarwal, B. 2010. *Gender and Green Governance: The Political Economy of Women's Presence Within and Beyond Community Forestry.* Oxford University Press. Cited in Lewark, S., George, L., and Karmann, M. 2011. Study of gender equality in community based forest certification programmes in Nepal. International Forestry Review, Vol. 13 (2).

the gender composition of CFUGs affects forest management decisions, finding that groups with a high proportion of women in their decision-making body show significantly greater improvements in ecological forest condition than those with fewer women. Nepalese CFUGs led by women have been found to have better forest regeneration and canopy growth than other groups, despite receiving smaller and more degraded forests. Groups with more women in the governing body are especially effective in enhancing other women's participation.[171]

A study of CFUGs in Sushpa and Bhitteri found women and men to be engaged in broadly similar tasks having to do with forest management. There was a difference, however, in levels of awareness amongst women and men members, possibly due to women's restricted networks and greater domestic workload. Men were found to be more aware of official procedures and management issues, while women were less so, and focused on issues such forest opening and closing times and quantities of firewood, grass and leaf litter that they could collect to have a constant supply of basic necessities for their households.[172]

In the districts, likely to be affected by compact projects, an average of nearly 57% CFUG leaders are women (see Table 31). In some areas, the percentage of women CFUG leaders are remarkably high, such as Kailali (84%) and Tahahu and Ramechap (72%). Only in Morang does women's CFUG leadership dip below 30%. It is interesting to note that Kailali, where a quarter of households are reported to have 'absent members', is also an area where out-migration for work is increasing enormously for both men and women. As tracked by the "absent member in household" census indicator, there has been a 226% and 434% increase (for men and women, respectively) over the last decade. (Nepal Central Bureau of Statistics, 2001, 2011).

Table 31. Women's Leadership of CFUGs in Affected Districts

| Project | District | Total | Male | Female | Women in CFUG | % Women CFUG Leaders |
|---|---|---|---|---|---|---|
| NR3 | Ilam | 293,388 | 140,606 | 162,781 | 72,898 | 42 |
| | Morang | 1,019,421 | 485,485 | 533,937 | 72,573 | 29 |
| | Sunsari | 733,939 | 352,375 | 381,563 | 20,008 | 63 |
| **TOTAL** | | **2,046,748** | **978,466** | **1,068,281** | **165,479** | |
| NR1 | Sindupalchok | 280,960 | 133,237 | 147,723 | 121,681 | 43 |
| | Kathmandu | 2,111,651 | 1,097,710 | 1,013,941 | 35,444 | 63 |
| | Nuwakot | 273,267 | 129,006 | 144,261 | 87,982 | 40 |
| | Makwanpur | 432,292 | 209,779 | 222,512 | 138,592 | 50 |
| | Chitwan | 629,978 | 298,914 | 331,064 | 73,915 | 46 |
| | Tanahu | 326,745 | 142,081 | 184,664 | 108,155 | 72 |

[171] Ibid.

[172] Ibid.

Table 31. Women's Leadership of CFUGs in Affected Districts

| Project | District | Total | Male | Female | Women in CFUG | % Women CFUG Leaders |
|---|---|---|---|---|---|---|
| | Palpa | 258,429 | 112,342 | 146,087 | 125,493 | 54 |
| | Nawalparasi | 679,293 | 314,481 | 364,813 | 86,622 | 50 |
| | Dhading | 335,188 | 154,732 | 180,456 | 158,502 | 65 |
| **TOTAL** | | **5,327,803** | **2,592,282** | **2,735,521** | **936,386** | |
| T2' | Dolakha | 180,032 | 82,302 | 97,729 | 86,166 | 54 |
| | Ramechap | 198,912 | 90,556 | 108,355 | 94,355 | 72 |
| **TOTAL** | | **378,944** | **172,858** | **206,084** | **180,521** | |
| T3 | Myagdi | 113,340 | 50,699 | 62,641 | 71,497 | 53 |
| | Parbat | 142,374 | 62,480 | 79,894 | 86,651 | 63 |
| **TOTAL** | | **255,714** | **113,179** | **142,535** | **158,148** | |
| NR4 | Doti | 214,043 | 94,852 | 119,191 | 58,582 | 47 |
| | Dadeldhura | 149,053 | 68,933 | 80,120 | 94,294 | 50 |
| | Baitadi | 257,888 | 118,991 | 138,896 | 89,809 | 62 |
| | Kailali | 850,585 | 408,624 | 441,961 | 236,911 | 84 |
| | Darchula | 138,097 | 65,198 | 72,900 | 42,461 | 69 |
| **TOTAL** | | **1,609,666** | **756,598** | **853,068** | **522,057** | |
| XB1 | Nawalparasi | 679,293 | 314,481 | 364,813 | 86,622 | 50 |
| T8 | Kailali | 850,585 | 408,624 | 441,961 | 236,911 | 84 |

Beyond the value of engaging with women in CFUG leadership, a PESIA field visit to Hetauda demonstrated two issues of particular interest to this PESIA and eventual compact implementation. One relates to non-timber forest products (NTFP) and their importance in general for potential poverty reduction and in particular for women. The multiple uses of forests and the role that CFUG can play was shown with women in four separate groups receiving training on wood carving as part of an income-generating scheme organized by CFUG leadership in conjunction with local trainers. Another issue is the opportunity for using CFUG as **awareness-raising** mechanisms for women, for example during stakeholder consultation. The women consulted in Hetauda reported that they knew little of how they might use forest products for income generation, viewing forests as good for 'fodder and firewood' until the training scheme was launched.

**Gender Performance**

The 2010 Human Development Report introduced the Gender Inequality Index (GII), which reflects gender-based inequalities in three dimensions: reproductive health, empowerment, and economic activity. Reproductive health is measured by maternal mortality and adolescent birth rates; empowerment is measured by the share of parliamentary seats held by women and attainment in secondary and higher education by each gender; and economic activity is measured by the labor market participation rate for women and men. The GII can be interpreted as the loss in human development

due to inequality between female and male achievements in the three GII dimensions. Nepal has a GII value of 0.489, ranking it 108 out of 155 countries in the 2014 index.

In Nepal, 29.5% of parliamentary seats are held by women, and 17.7% of adult women have reached at least a secondary level of education compared to 38.2% of their male counterparts. For every 100,000 live births, 190 women die from pregnancy related causes; and the adolescent birth rate is 73.7 births per 1,000 women of ages 15-19. Female participation in the labor market is 79.9% compared to 87.1 for men.

In a recent report on gender equality by the Asian Development Bank,[173] it is observed that discrimination against women and girls is more severe in the lowland plains of the country, the Tarai, and in the mid- and far-western regions, creating a fertile ground for trafficking and child labor. At each level in the caste system or within an ethnic group, women were found to be more disadvantaged than men. It is estimated that the entire population of Dalit women live below the official poverty line. The literacy rate is on average 7% among Dalit women, and life expectancy 10–14 years lower than that for high-caste women.

The firmly ingrained gender division of labor in Nepal has long required that women undertake almost all domestic duties, including the time-consuming tasks of firewood and water collection. Women spend many more hours than men on household work, limiting women's productive and social activities, and girls' school attendance. Outside the home, women are generally engaged in semiskilled and unskilled jobs closely related to their household tasks. For the same work, they generally earn about 70% of men's wages.[174] This percentage is not known when it comes to the informal sector, though it is known that in informal systems women are vulnerable to exploitation, shocks and unsafe work.

**Decision Making**

Despite the contributions women make to family livelihood, they usually have little say in household decision making. This lack of voice is replicated outside the home. Women's access to political and administrative positions has been minimal, especially for those from poor, low-caste, and ethnic minority groups. In 2004, 26 women held executive positions in local governments, compared with 8,000 men; only 30% of women representatives at the ward level were fully literate, thus limiting their understanding of government processes; 25% were not invited to meetings; and 39% of those who

[173] ADB 2016. *Gender Equality Results Case Study Nepal Gender Equality and Empowerment of Women Project*. The project, approved in 2004, continued to 2013, covering 82 VDCs in 8 districts in the western region, and 42 VDCs in 7 districts in the central region, among the most disadvantaged areas in the country. The subsequent paragraphs in this report are taken from that study.

[174] During the site visits, it was observed that daily wages in the Tarai were NRs400 for men, but NRs350 for women. However, at the Saule Bazar (Dadeldhura) substation (control room) construction site, men and women were being paid equal wages at NRs500 a day, with no meals, and accommodation only for men. Information was obtained through direct interviews by the Cenibark/TT Social Specialist (Akanda) with laborers, both male and female, at the control room construction site.

attended only listened. However, more recently there has been progress in women's political representation. Due to reservation quotas and age restrictions (40 for females, 35 for males) in the Civil Service Act amended in 2007, women officers nearly doubled to 22.85% in 2013 from 12.97% in 2010. Most dramatically, women's representation in the Constituent Assembly increased to 29% in the November 2013 elections from 2.9% in 1991. In October 2015, the first female President was elected in the country. It is also worth noting that the chief justice of the Supreme Court is a woman.

In terms of deciding development-related funding priorities for communities, a 14-step process was initiated five years ago with the joint cooperation of the Local Governance and Community Development Program[175] and various development partners which links Ward-level requests to the central government level through Ward Citizen's Forum (WCF) and Citizen Awareness Center (CAC) - a group formed for disadvantaged groups. Guidelines exist to ensure that funds are apportioned to address the needs of women and members of marginalized groups. Social mobilisers work at village level, and WCFs and CACs—both with a rotating leadership to ensure gender-balance—organize local development fund requests, which go first to the Village Development Committees (VDCs), which must either fund requests from their own (limited) budgets, or pass those along to the Ilaka Council, generally consisting of 5-8 VDCs. This Council is made up of VDC Secretaries, political party representatives and civil society members. From there, prioritized requests go to the District Development Committee (DDC) for further prioritizing and sorting, and from there to relevant Ministries.

Looking at this process through a gender/exclusion lens, there are both opportunities and constraints. At the "lowest" levels, women's participation is ensured and institutionalized through requirements that the WCFs are representative and women's involvement with social mobilizers, who run a training course throughout the year to initiate people, particularly women, into the processes of identifying and putting forward their needs. When requests for funding are evaluated at VDC, Ilaka and DDC levels, they are measured against a set of official criteria which include dimensions of gender equality and social inclusion. However, the very rapid, initial field visit that was conducted as part of the feasibility stage raised the question of the quality and lack of impact of women's participation in the face, which will be further investigated during preparation of the Environmental and Social Impact Assessment (ESIA). In its evaluation of the *Enhancing Political Participation of Marginalized Women in Nepal* project, the United Nations Democracy Fund (UNDEF) found that women's groups, although organized, empowered, active and informed, had "*limited understanding of and access to local policy processes. They had no opportunity to participate in the local and political development agenda or to share their views with local authorities or political parties*."[176]

**Violence**[177]

[175] Covering 75 Districts, 191 Municipalities and 3,276 Village Development Committees.

[176] UN Democracy Fund 2011. *Enhancing Political Participation of Marginalised Women in Nepal: Evaluation Report*. P.11.

[177] See UN Country Team Gender Theme Group. Position Paper on Ending Violence Against Women and Girls in Nepal. 2016.

Both domestically and publicly, women have long been vulnerable to gender-based violence. In 2004, it was estimated that 95% of women and girls had firsthand knowledge of violence–77% from their own family members. Recent evidence (2011) shows that the situation has improved little and that one out of every two ever-married women (married women who may have been married at any time and may or may not still be married) aged 15-49 has experienced violence of some kind in her life. A 2012 study by the Office of the Prime Minister and Council of Ministers confirmed that gender-based violence and, in particular, domestic violence is prevalent and rarely reported. The chances of experiencing violence are higher among women in rural areas, those of low economic and educational status, and among women who are separated or divorced from their husbands.

**Transgender Recognition**

Mention must be made of Nepal's step in recognizing transgender issues. In 2007, Nepal's Supreme Court issued a ruling in *Pant vs. Nepal* allowing Nepalese to recognize their gender according to their perception that the male or female gender roles commonly identified by society do not match their true social, sexual, or gender identity, that is, who do not identify as either male or female. This has demonstrated not simply tolerance toward the transgender community in the country, but in legal recognition of their standing, allowed for them to have a clear voice in Nepal's socio-political structure. Currently there is a transgender Member of Parliament.

### 4.2.3 Benefit Sharing and Development Opportunities

The proposed project yields an important opportunity to provide benefits to those living in areas through which the transmission line passes (line catchment area), particularly as there will be no benefits from power derived directly from those lines. This benefit sharing can be considered part of establishing a Social License to Operate (SLO), a concept used by different types of organizations to consider the level of approval accorded to their operations by a local community, including identifying proactive actions they can take to increase the likelihood of a positive relationship with communities in which they will work. Building an SLO is "good business" in the context of Nepal, where community opposition is known to delay infrastructure work. It is underlined by a moral imperative, given the extreme want of many of the communities that will be impacted by, but not directly benefit from, the establishment of transmission lines.

## 4.3 NR1

### 4.3.1 Physical

The NR1, or "trunk line," 280 km in length, is the longest in the proposed list of compact projects, and with five new or supplemented substations, the most complex. More attention is devoted to it here than to the remaining six projects.

NR1 will be a high-tension, 400 kV double circuit line with a 46 m right of way, 23 m on either side of the transmission line. The new or augmented substations are detailed in Table 32. The route is illustrated on the map in Figure 31.

Table 32. Details of NR1 Transmission Line and Substations

| | Substations | | | Transmission line | |
|---|---|---|---|---|---|
| Reference | Name | Foot-print | Details | Details | Length (km) |
| NR1 | Hetauda | N/A | No land acquisition | 400 kV double circuit<br><br>ROW = 46 m | ~280 |
| | Naubise (Galcchi) | ~250 x 300m | Land acquisition, some structures | | |
| | Lapsiphedi (Haledi) | TBD | No land likely to be acquired by MCC. TBD | | |
| | New Damauli | ~250 x 250m | Land acquisition, farm land | | |
| | New Butwal | ~250 x 250m | No land acquisition | | |


**Figure 31 Alignment and Substations of NR1**

**Geology and Soils**

The proposed transmission line traverses through the Kushma formation, Seti formation, Sangram formation, Syangja formation, Galyang formation, Swat formation, Lakharpata formation, Middle Siwalik, etc. The project area lies in a geologically risky zone since the alignment passes through the Chure region in parts of Palpa and Nawalparasi districts. In general, land stability is weak and prone to sliding due to steep slopes. However, no major active landslide zone was observed around the proposed substation sites and 220 kV TL alignment.

The route traverses all the types of terrain in Nepal except the high mountains and Himalayas. Therefore, close examination of each small segment would be necessary to fully characterize the environment. However, key statistics on landslide potential, the chief physical characteristic of concern, give an idea of the range of physical challenges. See Table 33 and Table 34.

Table 33. Percentage Distribution of Earthquake-induced Landslide Potential

| District | Negligible (%) | Low (%) | Medium (%) | High (%) |
|---|---|---|---|---|
| Makwanapur | 48.40 | 40.72 | 3.04 | 7.24 |
| Dhading | 7.88 | 30.08 | 5.24 | 56.80 |
| Nuwakot | 3.49 | 30.08 | 8.19 | 56.17 |
| Sindhupalchok | 14.78 | 40.14 | 6.50 | 38.59 |
| Kathmandu | 20.44 | 43.98 | 4.70 | 21.88 |
| Nawalparasi | 72.36 | 24.30 | 2.17 | 1.00 |
| Palpa | 28.37 | 59.93 | 11.23 | 0.47 |
| Tanahu | 4.32 | 33.28 | 4.84 | 57.57 |
| Chitawan | 79.56 | 10.80 | 1.91 | 7.74 |

Source: Nepal Hazard Risk Assessment, Asian Disaster Preparedness Center, Norwegian Geotechnical Institute, and Centre for International Studies and Cooperation, undated, p. 45.

Table 34. Percentage Distribution of Precipitation-Induced Landslide Potential

| District | Negligible (%) | Low (%) | Medium (%) | High (%) |
|---|---|---|---|---|
| Makwanapur | 10.50 | 51.18 | 25.94 | 6.38 |
| Dhading | 11.26 | 35.55 | 45.42 | 7.78 |
| Nuwakot | 17.36 | 47.82 | 31.34 | 3.48 |
| Sindhupalchok | 15.34 | 46.80 | 34.16 | 3.51 |
| Kathmandu | 48.09 | 40.47 | 8.89 | 2.55 |
| Nawalparasi | 36.05 | 23.15 | 21.65 | 19.45 |
| Palpa | 3.27 | 12.34 | 36.53 | 47.86 |
| Tanahu | 8.51 | 22.17 | 43.36 | 25.95 |
| Chitwan | 36.12 | 41.40 | 17.28 | 6.20 |

Source: Nepal Hazard Risk Assessment, Asian Disaster Preparedness Center, Norwegian Geotechnical Institute, and Centre for International Studies and Cooperation, undated, p. 45.

**Ecological**

The transmission line transects a variety of landscapes in the mid-hills and Tarai regions. Use of the LRT multi-criteria routing tool, and detailed analysis by a multidisciplinary routing team has produced and alignment that avoids most environmentally sensitive areas and many structures. A wide variety of forest and other vegetation types exist in the area, and the route crosses a substantial portion of the Chitwan Annanpurna Landscape (CHAL) as well as a small portion of the Tarai Arc Landscape (TAL).

Ecological zones of the route are shown in Table 35.

Table 35. Ecological Zonation of NR1 Project

| District | Lower tropical (%) | Upper tropical (%) | Sub-tropical (%) | Temperate (%) | Sub-Alpine (%) | Alpine (%) |
|---|---|---|---|---|---|---|
| Makwanapur | 7.2 | 59.0 | 28.9 | 4.9 | | |
| Dhading | 0.0 | 39.7 | 35.1 | 10.8 | 7.7 | 3.2 |
| Nuwakot | 28.6 | 50.8 | 13.4 | 3.9 | 1.3 | |
| Sindhupalchok | | 6.0 | 37.2 | 24.5 | 15.1 | 7.8 |
| Kathmandu | | | 88.2 | 11.8 | | |
| Nawalparasi | 56.2 | 34.9 | 5.7 | | | |
| Palpa | 0.3 | 51.3 | 47.3 | | | |
| Tanahu | 2.3 | 88.0 | 8.8 | 0.0 | | |
| Chitwan | | | | | | |

Source: Barnekow Lillesø, J-P., Shrestha, T. B., Dhakal, L. P., Nayaju, R. P., & Shrestha, R. (2005). The map of potential vegetation of Nepal: a forestry/agro-ecological/biodiversity classification system. Hørsholm: Center for Skov, Landskab og Planlægning/Københavns Universitet. (Development and Environment; No. 2/2005).

This transmission line passes through Bagmati, Gandaki, Naryani and Lumbini zones, Kathmandu, Sindhupalchok, Nuwakot, Dhading, Chitwan, Tanahu, Nawalparasi, Palpa and Makwanpur districts. It extends from Hetauda to Naubise, from Naubise to Lapsephedi, from Naubise to Damauli and then from Damauli to New Butwal.

The proposed project area lies in the hill, Siwalik and Tarai regions of Nepal. The project area within Kathmandu, SIndhupalchwok, Nuwakot, Dhading, Makwanpur, Chitwan, Tanahun and Palpa districts is part of hill region, while some parts to the south of Palpa and Nawalparasi district fall under Siwalik. Then, to its south, the project area within southern part of Nawalparasi districts belongs to the Tarai. The proposed 400 kV TL route passes through cultivated land, forest, bush, grassland, cut area, sand and river.

***Major River Crossings.*** The proposed NR1 alignment crosses the Tadi River in Nuwakot District, Trishuli River in Dhading/Chitwan District, Seti River in Tanahun District, and Kaligandaki River between Tanahun and Palpa Districts.

***Biological Environment.*** Geographic and climatic conditions determine the biological environments of particular areas. The project area's bio-climatic zones range from sub-temperate to sub-tropical. The proposed substations and TL alignment are not located within a national park, wildlife sanctuary, buffer zone or conservation area.

The Sal tree (Shorea robusta) is a hardwood valued for construction, and also has sacred significance in Nepal. Several parts of the plant have commercial value.

**Forest and Vegetation**

The project area's natural forests can be categorized as pine forest, broad leaf forest, mixed forest and Sal forest. The major tree species are Pine (*Pinus roxburghii*), Chilaune (*Schima wallichii*), Mauwa (Engelhardia *spicata*), Sisau (*Dalbergia sisoo*), and Sal (*Shorea robusta*) along the proposed TL route.

**Flora**

Various medicinal plants and non-timber forest products are abundantly in the forests of hills and high mountains. The major tree species found in the project area are Sal (*Shorea robusta*), Chilaune (*Schima wallichii*), Khotesalla (*Pinus roxburghii*), Mauwa (*Engelhardia spicata*), Saj (*Terminalia alata*), Simal (Bombax ceiba), Kutmero (*Litsea monopelata*), and Siris (*Albizia sp*.). Bhalayo (*Semecarpus anacardium*), Dhayero (*Woodfordia fruticosa*), and Dhursul (*Coleobrookea oppositifolia*) are the major shrub species in the project area.

Siltimur (*Lindera neesiana*), Lapsi (*Choerospondias axillaris*), Chutro (*Berberis aristata*), Ainselu (*Rubus ellipticus*), Timur (*Zanthoxylum armatum*) and Amala (*Phyllanthus emblica*) are the important medicinal plants observed in the project area.

**Fauna**

The distribution of wildlife in the project area is not uniform and depends upon habitat type, topographic factors, and human influences. However, common wild animals like jackal (*Canis aureus*), Bandar (*Macaca mulatta*), Dhumsi (*Histrix indica*), Malsanpro (*Martin flavigula*), Rhesus Monkey (*Macaca mullata*), and Common Langur (*Presbytes entellus*) are reported in the project area.

Mixed forest, bamboo groves, agricultural fields, villages, rivers, and streams provide a variety of habitats for different species of birds. Normally, the course of a large river like the Kali Gandaki is a route for migratory birds.

**Rare, Endangered and Protected Species of Flora and Fauna**
Some species of flora and fauna in the project area might be categorized as rare, endangered or protected species as per Government of Nepal (GoN) regulations, the International Union for the Conservation of Nature (IUCN) and/or the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). The major endangered species identified during site visits is the Chinese Pangolin.

**Ethno Botany/ Plant Resource Use Patterns**
Plants like Sal (*Shorea robusta*) and Saj (*Termialia alata*) are extensively harvested for timber. Almost all plant species are used for firewood and various plants are used as fodder. Kaphal (*Myrica esculenta*), Ainselu (*Rubus ellipticus*) and Amala (*Phyllanthus emblica*) are edible fruits reported in the project area. Tree species like Sal (*Shorea robusta*) and Simal (*Bombax ceiba*) are listed as protected species by the GoN are found in the project area.

### 4.3.2 Socio-Economic

A socio-economic profile of the districts affected by NR1 is shown in Table 36.

**Land Use**
The project area consists of fertile cultivated land, forests, grazing land and barren land. Agricultural products mainly include food crops (paddy, wheat, maize, millet, and potato) and cash crops (oilseeds, fruits and vegetables). The cropping pattern in the project area is paddy-wheat, paddy-wheat-vegetable, paddy-oilseed-vegetable, paddy-pulses, paddy-vegetable, and maize-pulses-oilseed.

Livestock and poultry farming are also common in the project affected village development communities (VDCs)/municipalities. Livestock, including goats, cattle, buffalos, and chickens, are sold in the local market for supplementary income. Chemical fertilizers, insecticides and improved seeds for agriculture purposes are normally used in the project area.

Table 36. Socio-economic Profile of NR1 Districts

| All NR1 Districts: Chitwan, Dhading, Kathmandu, Makwanpur, Sindupalchok, Nuwakot, Tanahu, Palpa, Nawalparasi | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Area ($Km^2$) | All NR1 Districts: Population | | | | All NR1 VDCs | VDCs – Population (Total) | | | |
| | Total | M | F | HH | | Total | M | F | HH |
| 15,709 | 4,874,013 | 2,390,669 | 2,471,915 | 1,121,080 | 55 | 473,484 | 233,984 | 245,287 | 105,571 |

| Agriculture (ha) | | Pasture | Forest | Community Forest | | Leasehold Forest | | | NR1 Poverty Rate | NR1 Poverty no KTM |
|---|---|---|---|---|---|---|---|---|---|---|
| Cultiva-ted | Not Cultivated | (ha) | (ha) | Area (ha) | CFUGs | Area (ha) | Groups | HH | | |
| 368,875 | 151,522 | 177,288 | 868,115 | 244,432 | 3,225 | 10,582 | 2,221 | 17,676 | 13% | 16% |

Notes: All figures are from National population and Housing Census 2011 (NPHC 2011), November 2012;
VDCs are those through which transmission line passes or in which substations are located;
The poverty rate (rounded, below) is the headcount ratio, the proportion of the population that lives below the poverty line; at the time of the 2011 Census, an individual was considered poor is his/her per capital income was below NRs 19,261.

| **Economic Activity Performed** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Total population 10 years and above | Economically Active | | | | | | Not Economically Active | | Economic Activity Not Stated | |
| | Usually Active | | | | Not Usually Active | | | | | |
| | Employed | | Unemployed | | | | | | | |
| | Male | Female | Male | Female | Male | Female | Male | Female | Male | Female |
| 3,944,517 | 726,380 | 417,959 | 45,328 | 41,992 | 30,851 | 145,424 | 478,401 | 625,972 | 10,912 | 9,805 |

| **Usual Activity Performed** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Total person | Own Agriculture | Wage/ Salary Earning | Own Non-Agricultural | Extended Economic | Seeking Job | House-hold Chores | Study | Non-activity | Not Stated | % Non-ag employ-ment |
| 3,944,517 | 1,162,013 | 799,528 | 445,608 | 353,242 | 111,173 | 1,157,535 | 1,202,373 | 410,250 | 31,778 | 60% |

Table 37. Sex of Household Heads for NR1 Districts

| | Chitwan | Dhading | Kathmandu | Makwanpur | Sindhupal chok | Nuwakot | Tanahu | Palpa | Nawalparasi | Totals |
|---|---|---|---|---|---|---|---|---|---|---|
| **Totals** | 132,462 | 73,851 | 436,344 | 86,127 | 66,688 | 59,215 | 78,309 | 59,291 | 128,793 | 1,121,080 |
| Male | 87,824 | 53,303 | 315,057 | 66,705 | 50,651 | 46,603 | 44,876 | 35,194 | 91,498 | 791,711 |
| Female | 44,638 | 20,548 | 121,287 | 19,422 | 16,037 | 12,612 | 33,433 | 24,097 | 37,295 | 329,369 |
| **Percent** | | | | | | | | | | |
| Male | 66.3% | 72.2% | 72.2% | 77.4% | 76.0% | 78.7% | 57.3% | 59.4% | 71.0% | 70.6% |
| Female | 33.7% | 27.8% | 27.8% | 22.6% | 24.0% | 21.3% | 42.7% | 40.6% | 29.0% | 29.4% |

Source: National population and Housing Census 2011 (NPHC 2011), November 2012

**Chitwan**

The Chitwan District, in which only one VDC will be affected by the project, is best known for the Chitwan National Park, a protected area that houses a wide diversity of flora and fauna, including several endangered species. The District is primarily planted to cash crops such as rice and maize (Chitwan produces over 4% of total maize production on a national cultivation area of some 825,000 hectares), and vegetables. Chitwan is also famous for floriculture, mushroom cultivation and bee keeping, much of which are household-level activities. The District is relatively prosperous, with high food security levels and at 84%, a much higher degree of literacy than other districts. However, the eastern VDCs of the District do show perceptible concentrations of disadvantaged groups with lower social and economic indicators.[178] Over 17% of households are female-headed. Chitwan is among the districts that have the highest scores on UNDP's Human Development Index[179] (see Table 38).

Table 38. Human Development Index (HDI) by District in Nepal

| HDI Values | Districts with HDI score in ascending order | Number of Districts |
|---|---|---|
| < .400 | Bajura, Bajhang, Kalikot, Humla, Achham, Rautahat, Mahottari, Jajarkot, Rolpa, Mugu | 10 |
| .400 –.449 | Dolpa, Sarlahi, Doti, Siraha, Jumla, Pyuthan, Baitadi, Dailekh, Rukum, Dhanusha, Kapilbastu, Darchula, Saptari, Sindhuli, Salyan, Dadeldhura | 16 |
| .450 – .499 | Sindhupalchowk, Bara, Dolakha, Kailali, Rasuwa, Dhading, Parsa, Gulmi, Nuwakot, Bardiya, Okhaldhunga, Ramechhap, Kanchanpur, Udaypur, Baanke, Surkhet, Baglung, Bhojpur, Gorkha, Arghakhanchi, Dang, Sankhuwasabha, Myagdi, Nawalparasi, Khotang, Taplejung, Sunsari, Makwanpur, Rupandehi, Paanchthar | 30 |
| .500 – .549 | Palpa, Solukhumbu, Tanahu, Lamjung, Mustang, Parbat, Morang, Dhankuta, Jhapa, Kavrepalanchowk, Illam, Terhathum, Syangja | 13 |
| > .550 | Chitwan, Manang, Bhaktapur, Kaski, Lalitpur, Kathmandu | 6 |

Source: Nepal Human Development Report. *Beyond Geography Unlocking Human Potential*. UNDP. 2014. Page 15.

**Dhading**

[178] Defined by UN as a composite that includes, among others, prevalence of gender discrimination, presence of vulnerable households, concentration of marginalized households, and participation of women, Dalits and janjatis in planning, execution and decision-making. *UN Nepal Information Platform*. District Profile. 2011,

[179] The UNDP's Human Development Index (HDI) is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and have a decent standard of living.

Dhading is unique in that it is the only district that stretches from the Tarai to the mountains, with some of the country's highest peaks. The District, 11 VDCs of which will be affected by the project, has high percentage of poor and marginalized ethnic populations, including Chepangs and Dalits, whose socioeconomic condition in well below the average population of the district. The District was among the most severely affected by the 2015 earthquake, with almost 1,000 deaths and injuries, some 20,000 buildings destroyed (including 70% of schools), and about 100,000 persons affected. The situation was particularly difficult for women, especially women-headed households, and created safety concerns for young girls who would be susceptible to increased incidence of trafficking. With its proximity to Kathmandu, Dhading presents opportunities for job seekers targeting Kathmandu as their destination. Working in restaurants, the transport sector and brick kilns are not uncommon activities, though these provide ready avenues for forced and child labor as well as legitimate jobs. Women in Dhading fall relatively low on the scale of those who own fixed assets in the region (see Table 39) and face serious education challenges, with 42% unable to read and write. Labor out-migration is on the rise for both women and men; although absolute numbers are not huge, the figure for 'absent' women in households has increased 231% over the decade 2001-2011, while for men the increase is 117%.[180]

Table 39. Women's Ownership of Fixed Assets in Affected NR-1 Districts

| District | Women who own land (%) | Women who own both house and land (%) | Women owning neither house nor land (%) | Planned Substation |
|---|---|---|---|---|
| Kathmandu | 7.00 | 10.89 | 61.40 | ✓ |
| Sindupalchok | 4.60 | 4.20 | 69.00 | |
| Nuwakot | 5.30 | 5.00 | 60.70 | |
| Makwanpur | 5.50 | 8.80 | 59.00 | |
| Dhading | 5.30 | 1.40 | 63.40 | ✓ |
| Chitwan | 8.40 | 12.30 | 51.00 | |
| Tanahu | 7.20 | 9.60 | 56.00 | ✓ |
| Palpa | 6.30 | 7.00 | 57.00 | |
| Nawalparasi | 6.50 | 9.50 | 49.00 | ✓ |
| Note: "Women" are defined as those over 19. | | | | |

**Kathmandu**

The Kathmandu Valley is the capital region. It is densely populated and being highly urbanized with several major towns aside from Kathmandu, has a heterogenous population of castes and ethnic communities that have largely blended into the "anonymity" of the urban landscape.[181] Project activities

[180] All household statistics area drawn from CBS. 2011

[181] It has been noted that "While urbanization does not change caste identities, it does make them less relevant in places where questions about caste are not easily asked." C. Britt. *Initial Social and Gender Assessment Report*. 2013. Page 8.

will take place in two northern VDCs, characterized by paddy and maize cultivation, livestock rearing and vegetable production. The area was severely affected by the 2015 earthquake, and there is still much temporary housing visible. Being close to the capital region, the populations are relatively better-off, with high literacy rates among both men and women. Kathmandu is an outlier amongst most districts of Nepal in that its population balance favors men; the sex ratio (proportion of men to women in the population) is nearly 110—a high figure when placed against regions such as Palpa, also affected by NR1, where the ratio is 77 men for every hundred women (Table 38). Rates of out-migration for work are climbing quickly for men in Kathmandu (a 392% increase during the decade 2001-2011), but even more so for women (a 642% increase during that same period).

Table 40. Sex Ratios for all Project-affected Districts

| Project | District | M/F sex ratio (2001) | M/F sex ratio (2011) | M/F sex ratio (2015)[182] |
|---|---|---|---|---|
| **NR1** | Kathmandu | 114 | 109.84 | 108.26 |
| | Sindupalchok | 99 | 92.58 | 90.19 |
| | Nuwakot | 98 | 91.78 | 89.43 |
| | Makwanpur | 103 | 96.67 | 94.28 |
| | Dhading | 96 | 88.55 | 85.74 |
| | Chitwan | 99 | 92.75 | 90.29 |
| | Tanahu | 87 | 79.73 | 76.94 |
| | Palpa | 87 | 79.7 | 76.9 |
| | Nawalparasi | 98 | 89.36 | 86.2 |
| **NR3** | Ilam | 101 | 94.63 | 92.03 |
| | Morang | 101 | 93.59 | 90.93 |
| | Sunsari | 101 | 94.64 | 92.35 |
| **NR4** | Darchula | 96 | 91.3 | 89.44 |
| | Baitadi | 94 | 87.95 | 85.67 |
| | Dadeldhura | 94 | 88.11 | 86.04 |
| | Doti | 100 | 89.94 | 79.58 |
| | Kailali | 103 | 95.25 | 92.46 |
| **T2'** | Ramechhap | 90 | 85.47 | 83.57 |
| | Dolakha | 96 | 87.93 | 84.21 |
| | Solukhumbu | 98 | 93.63 | 92.1 |
| **T3** | Myagdi | 87 | 82.57 | 80.94 |
| | Parbat | 86 | 80.33 | 78.2 |
| | Baglung | 85 | 78.345 | 75.85 |
| **T8** | Kailali | 103 | 95.25 | 92.46 |
| **Xb1** | Nawalparasi | 98 | 89.36 | 86.2 |

[182] Estimated.

**Makwanpur**

Makwanpur District, six VDCs of which will be affected by the Project, is located south of Kathmandu, and has middle and high hills, and flatlands, with largely subsistence agriculture farming as the key occupation. Owing to its border with Chitwan and its protected parks, nearly 9% of Makwanpur is in conservation areas. Makwanpur was hard hit by the earthquake, with almost 14,000 people affected. Hetauda, a large industrial municipality, will be the site of a new substation with the customary social impacts of new construction. Over 80% of the population in Makwanpur depends on agriculture; major crops include vegetable, grains, potato and fruits, along with some livestock rearing. There are several industries—cement, pharmaceutical and multi -national (Unilever), giving rise to both legitimate and exploitative employment. 22 VDCs out of 37 are connected to the grid, with full electrification in 34% of VDCs, partial electrification in 29%. As with other districts in the vicinity, labor out-migration is on the rise for both men and women, an increase of 593% and 451% over the past decade, respectively. Makwanpur has the third-highest rate of TIP in the country. Various NGOs work in coordination with police and district government authorities in TIP prevention, protection and prosecution. A network of 28 NGOs serves the District to create awareness, provide education, skills and social rehabilitation of victims. There are four primary health centers, 10 health posts and 31 sub health posts in the District. 19% of women and 11% of men are unable to read and write.

**Sindupalchok**

While Sindhupalchok was one of the most-affected districts during the 2015 earthquake, the three southwestern VDCs through which the line passes managed to avoid the worst impacts. However, the district continues to go through post-earthquake reconstruction, and there is still considerable vulnerability to trafficking among local populations. Agriculture is the principal source of incomes, together with informal employment in portering and seasonal migration to India and the Middle East (one in five households has a member away). Though actual numbers are small, out-migration for women is sharply on the rise in this District, up nearly 400% from 2001 to 2011.

**Nuwakot**

Nuwakot lies north of Kathmandu, with the transmission line traversing nine central VDCs, then dropping midway into the Kathmandu Valley. Lately, there has been an increase in the occurrence of extreme events, such as floods and landslides, and together with reductions in groundwater, these have had a deleterious effect on the lives of communities in Nuwakot. On the social and gender front, poverty, illiteracy, caste-based discrimination and marginalization, and out-migration (both to the capital region and overseas) have all adversely affected quality of life, particularly for the disadvantaged. Although the District has a large area under community forest management, there are indications that the amount of forage has decreased, which has implications for the large livestock populations in the area. Nuwakot is another area where TIP and child labor is of significant concern, though NGOs (such as Maiti Nepal) have experience in working with authorities on this issue and are present in the District.

**Tanahu**

The transmission line runs east-west in and covers 15 VDCs in Tanahu, which lies in the middle of the country and is characterized by both forests and agricultural lands. Despite afforestation efforts, the forest cover is slowly diminishing. Tanahu is rich in water resources, with about 20 rivers in the district, include the Kali Gandaki and Seti; Janajatis are the dominant ethnic group, followed by high-case Brahmins. Overseas employment levels are high in the district, with nearly 45% of households having a member away.

**Palpa**

Palpa is a hill district, with agriculture the major occupation for 90% of the economically-active population. Most production is cereal crops (paddy, maize and millet), which together with fruits and vegetables are export items from the district. Cash crops include ginger and coffee. Rearing livestock, primarily used for draught power and transport, is important in the district, which makes forests an important source of fodder, foraging for which is regulated by CFUGs. NTFPs include a variety of herbs, for which the district is well known. Six VDCs will be traversed by the transmission line.

**Nawalparasi**

Two VDCs with 3% of the district population will be affected by the NR1 section of the line. The Nawalpur valley is the part of greater Chitwan Valley of inner tarai where the populations include Tharu, Magar and Brahmins who have migrated from the hills. There are several large industrial enterprises, including sugar, cement and pulp and paper factories, which account for considerable employment of locals. Half of Nawalparasi is mainly hilly areas populated largely by Brahmins, Magar and Chhetri castes, while the tarai area is mostly Tharu. With the longest stretch of the major east-west Mahendra Highway running across Nawalparasi, there is significant commercial traffic going into and through the District. With changing climatic conditions, the incidence of floods has increased the vulnerability of lowland communities. The forest areas are a source of considerable NTFPs, including herbs and medicinal plants that represent significant opportunities for income generation. Women's ownership of fixed assets is low in project-affected areas in XB1 and T8 Districts (Table 39).

Table 41. Women's Ownership of Fixed Assets in Affected T8 and XB1 Districts

| District | Women who own land (%) | Women who own both house and land (%) | Women owning neither house nor land (%) | Planned Substation |
|---|---|---|---|---|
| Kailali | 3.80 | 4.90 | 58 | ✓ |
| Nawalparasi | 6.50 | 9.50 | 49 | ✓ |

### 4.3.4 Cultural

The NR1 project traverse's numerous districts, with important cultural features that are described in Table 42.

Table 42. Important Cultural Sites Along the Proposed NR1 Route

| District | Site |
|---|---|
| NR1 | |
| Kathmandu | There are no famous/notable religious/historic sites within proposed TL route area in Kathmandu district. |
| Sindhupalchowk | **Patal Gupha/Sadashiva Gupha:** located in Bhotechaur VDC, this site is a cave of historic/religious importance. |
| Kavrepalanchok | **Palancho Bhagawati:** This is a site for worshipping the Goddess Durga. |
| Nuwakot | **Devighat:** located at the confluence of the Trishuli and Tadi rivers, this is a famous religious site that also has historic importance. |
| Dhading | No places of significant historic/religious importance were found within the proposed route. |
| Chitwan | No places of significant historic/religious importance were found within the proposed route. |
| Tanahu | **Chhmkeswori Mandir:** located in Chhimkeswori VDC, this is a famous religious site. |
| | **Bandipur:** located in the old headquarters of Tanahun district, this is an historic site. |
| | **Kotdurbar:** located in Kotdurbar VDC, this is an historic site. |
| | **Chhabdi Barahi:** famous religious site. |
| | **Dhor Barahi:** famous religious site. |
| Palpa | **Kandeledanda:** Located at Jhirbas VDC, this site is famous for sightseeing. |
| Nawalparasi | **Sitaram Mandir, Ramghat:** located at Benimanipur VDC, this is a religious site. |
| Makwanpur | **Bajrabarahi Mandir:** Located in Bajrabarahi VDC, this is a religious site |
| | **Trikhandeswor Mahadev Mandir:** located at Bhainse VDC, this is a religious place |
| | **Indrayani and Risheshwor Mandir:** located in Daman VDC, this is a religious site |
| | **Bhimsen and Batuk Bhairab Mandir:** religious site located at Bhimphedi VDC |
| | **Chaitya:** located at Chitlang VDC, this is an historic Buddhist religious site |

## 4.4 XB1

The XB1 transmission line route with substations is a relatively short southwesterly extension of the NR1 trunk line from the New Butwal substation to the Indian border. See Table 43.

Table 43. Details of XB1 Transmission Line and Substations

| | Substations | | | Transmission line | |
|---|---|---|---|---|---|
| Reference | Name | Foot-print | Details | Details | Length (km) |
| XB1 | New Butwal | ~250 x 350 m | Land to be acquired | 400 kV | 16.6 |
| | Border location, to be determined | ~250 x 350 m | Land to be acquired | | ROW = 46 m, 23 m from centerline |

### 4.4.1 Physical

The 16.6 km XB1 line lies entirely within the tarai region of Nepal, and in the single district of Nawalparasi. See Figure 32. . The green line on the figure is the Indian border; the exact crossing point is being determined. The terrain is flat, and landslide and erosion potential except at stream crossings is low. See Table 44 and Table 45.

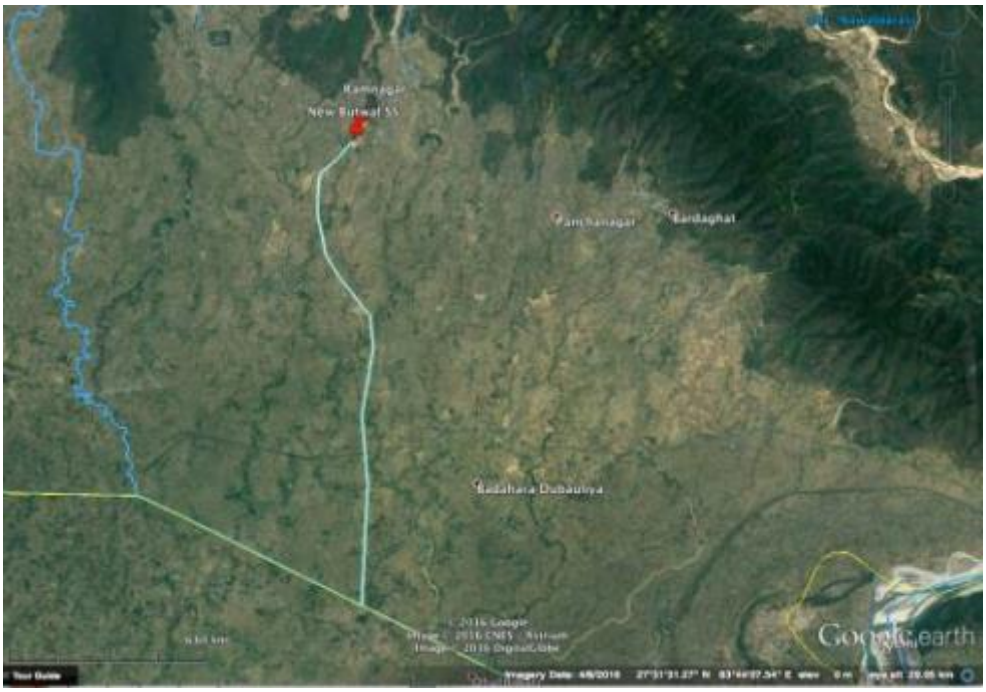


**Figure 32. XB1 Alignment with New Butwal Substation**

This landslide potential factor was considered primary for physical impacts and mitigations as it is partly a surrogate for erosion potential as well as landslides.

Table 44. Percentage Distribution of Earthquake-Induced Landslide Potential

| District | Negligible (%) | Low (%) | Medium (%) | High (%) |
|---|---|---|---|---|
| Nawalparasi | 72.36 | 24.39 | 2.17 | 1.09 |

Source: Nepal Hazard Risk Assessment, Asian Disaster Preparedness Center, Norwegian Geotechnical Institute, and Centre for International Studies and Cooperation, undated, p. 45.

Table 45. Percentage Distribution of Precipitation-Induced Landslide Potential

| District | Negligible (%) | Low (%) | Medium (%) | High (%) |
|---|---|---|---|---|
| Nawalparasi | 38.05 | 23.15 | 21.65 | 19.15 |

Source: Nepal Hazard Risk Assessment, Asian Disaster Preparedness Center, Norwegian Geotechnical Institute, and Centre for International Studies and Cooperation, undated, p. 45.

### 4.4.2 Ecological

The environment of the transmission line is tropical. See Table 46.

Table 46. Ecological Zonation of XB1 Project

| District | Lower tropical (%) | Upper tropical (%) | Sub-tropical (%) | Temperate (%) | Sub-Alpine (%) | Alpine (%) |
|---|---|---|---|---|---|---|
| Nawalparasi | 56.2 | 34.9 | 5.7 | | | |

Source: Barnekow Lillesø, J-P., Shrestha, T. B., Dhakal, L. P., Nayaju, R. P., & Shrestha, R. (2005). The map of potential vegetation of Nepal: a forestry/agro-ecological/biodiversity classification system. Hørsholm: Center for Skov, Landskab og Planlægning/Københavns Universitet. (Development and Environment; No. 2/2005).

Land use in the area traversed by the transmission line is primarily irrigated agriculture (rice and other medium- to high-value crops). The proposed routing avoids high density settlements. A typical area with river crossing is shown in Figure 33. .


**Figure 33. XB1 Project Typical Landscape. (Alignment Shown in Light Blue Color)**

### 4.4.3 Socio-Economic

A socio-economic profile of the district affected by XB1 is presented in Table 47.

**Nawalparasi**

Seven VDCs will be affected by XB1 project activities in addition to the two VDCs under NR1. XB1 VDCs contain just over 10% of the district population (see Table 47).

Table 47. Socio-economic Profile of XB1 District

| XB1 District: Nawalparasi | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Area ($Km^2$) | District Population | | | | VDCs | VDCs – Population (Total) | | | |
| | Total | M | F | HH | | Total | M | F | HH |
| 2,162 | 643,508 | 303,675 | 339,833 | 128,793 | 2: (Dhurkot; Ramnagar) | 21,000 | 9,656 | 11,344 | 4,295 |

| Agriculture (ha) | | Pasture | Forest | Community Forest | | Leasehold Forest | | | | Poverty Rate |
|---|---|---|---|---|---|---|---|---|---|---|
| Cultiva-ted | Not Cultivated | (ha) | (ha) | Area (ha) | CFUGs | Area (ha) | Groups | HH | | |
| 60,175 | 9.968 | 4,296 | 114,900 | 15,707 | 123 | 1,032.79 | 100 | 1,123 | | 17% |

Notes: All figures in this and following table are from National population and Housing Census 2011 (NPHC 2011), November 2012;
VDCs are those through which transmission line passes or in which substations are located;
The poverty rate (rounded, below) is the headcount ratio, the proportion of the population that lives below the poverty line; at the time of the 2011 Census, an individual was considered poor is his/her per capital income was below NRs 19,261.

| Economic Activity Performed | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Total population 10 years and above | Economically Active | | | | | | Not Economically Active | | Economic Activity Not Stated | |
| | Usually Active | | | | Not Usually Active | | | | | |
| | Employed | | Unemployed | | | | | | | |
| | Male | Female | Male | Female | Male | Female | Male | Female | Male | Female |
| 510153 | 25574 | 32601 | 252 | 90 | 4474 | 5946 | 16062 | 18365 | 340 | 481 |

| Usual Activity Performed | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Total person | Own Agriculture | Wage/ Salary Earning | Own Non-Agricultural | Extended Economic | Seeking Job | House-hold Chores | Study | Non-activity | Not Stated | % Non-ag employ-ment |
| 510153 | 220257 | 88421 | 54853 | 82948 | 18257 | 202413 | 150861 | 72879 | 3410 | 53% |

Table 48. Sex of Household Heads for XB1 District

| | Nawalparasi | |
|---|---|---|
| | Totals | Percent |
| total | 128,793 | 100% |
| Male | 91,498 | 71.0% |
| Female | 37,295 | 29.0% |

### 4.4.4 Cultural

No significant cultural resources have been identified within the XB1 corridor.

## 4.5 T8

### 4.5.1 Physical

The T8 transmission line is a relatively short line, running from the Lamki substation to the Indian border. The length is indeterminate until the Indian terminus is located, but is approximately 30 km. See Table 49 for project details, and Figure 34 for a map showing alignment and New Lamki substation.

Table 49. Details of T8 Transmission Line and Substation

| | Substations | | | Transmission line | |
|---|---|---|---|---|---|
| Reference | Name | Foot-print | Land acquisition, other | Description | Length (km) |
| **T8** | Lamki | ~250 x 350 m | Land to be acquired | 400 kV | ~30.25<br><br>ROW = 46 m, 23 m from centerline |
| | Border location, TBD | ~250 x 350 m | Land to be acquired | | |

Because most of the route and district are in the Tarai, landslide and erosion potential are low. See Table 50 and Table 51.

Table 50. Percentage Distribution of Earthquake-Induced Landslide Potential

| District | Negligible (%) | Low (%) | Medium (%) | High (%) |
|---|---|---|---|---|
| Kailali | 74.27 | 25.73 | | |

Source: Nepal Hazard Risk Assessment, Asian Disaster Preparedness Center, Norwegian Geotechnical Institute, and Centre for International Studies and Cooperation, undated, p. 45.

Table 51. Percentage Distribution of Precipitation-Induced Landslide Potential

| District | Negligible (%) | Low (%) | Medium (%) | High (%) |
|---|---|---|---|---|
| Kailali | 37.11 | 34.47 | 21.20 | 7.22 |

Source: Nepal Hazard Risk Assessment, Asian Disaster Preparedness Center, Norwegian Geotechnical Institute, and Centre for International Studies and Cooperation, undated, p. 45.

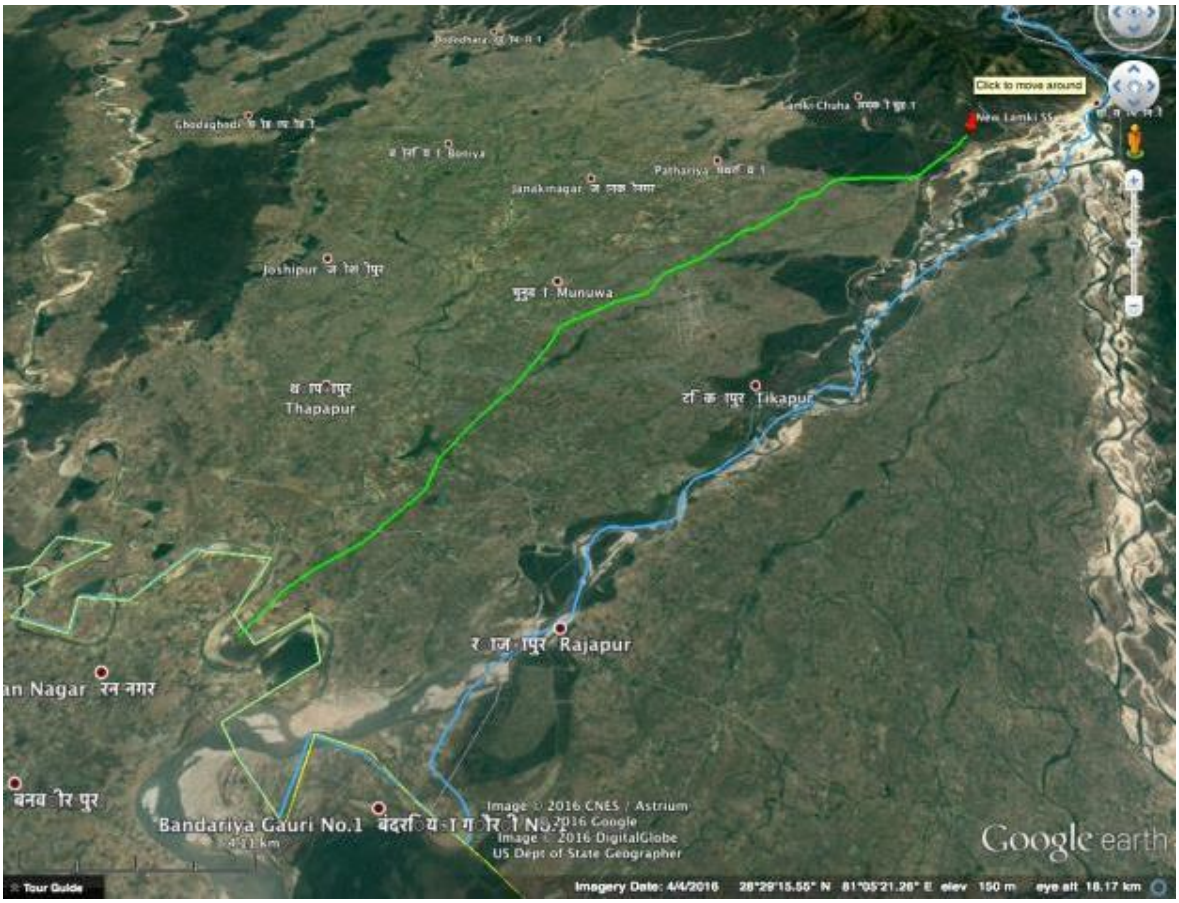


**Figure 34. T8 Project Alignment from New Lamki Substation to Border (green color)**

### 4.5.2 Ecological

The entire project area has been settled and disturbed for many generations. Very little pristine environmental resources remain, except for a portion of community forest that is transected in the northern 2 kilometers of the route. The existing Lamki substation is in a more densely settled area. Otherwise, lands are utilized for rice cultivation and scattered settlements, with homesteads planted to vegetables. Ecological zonation is shown in Table 52.

Table 52. Ecological Zonation of T8 Project Area

| District | Lower tropical (%) | Upper tropical (%) | Sub-tropical (%) | Temperate (%) | Sub-Alpine (%) | Alpine (%) |
|---|---|---|---|---|---|---|
| Kailali | 56.2 | 34.9 | 5.7 | | | |

Source: Barnekow Lillesø, J-P., Shrestha, T. B., Dhakal, L. P., Nayaju, R. P., & Shrestha, R. (2005). The map of potential vegetation of Nepal: a forestry/agro-ecological/biodiversity classification system. Hørsholm: Center for Skov, Landskab og Planlægning/Københavns Universitet. (Development and Environment; No. 2/2005).

**Figure 35. Typical Rice Paddy Agricultural Activity in T8 Project Area**
Source: Tetra Tech field visit report for T8 project area, 27-28 September 2016

Any reconstruction of substation facilities will require careful attention to the possibility of liberating hazardous wastes such as PCBs. The existing station does not appear to be well maintained. See Figure 36. .

**Figure 36. Existing Lamki Substation for T8 Project**

### 4.5.3 Socio-Economic

A socio-economic profile of the district affected by T8 is presented in Table 53.

**Kailali District**

For the most part, Kailali lies in Tarai belt with varied topography, from flatlands to moderately high hills, and is largely populated by Tharus. With major rivers, such as Karnali, Mohan, Kada Kamara, and Surmi, Kailali is principally an agriculture-based economy. Being part of the Far Western region with accessible borders, Kailali is a fast-growing area with significant in-migration. Seven VDCs with about 20% of the district population will be affected by project activities under T8; the impacts of a new substation construction and upgrading of another in urbanized Tikapur will be significant. Despite not having had a long history of TIP, this practice is picking up in the western districts. Kailali reports 30-35 person trafficked every year, out of which 9-10 are intercepted. Those vulnerable to TIP include a range of castes and ethnicities (Tharus, Muslims, Dalits, and Brahmin/Chhetris).

There are several NGOs involved in prevention and protection and work in close coordination with the police, court and other authorities. The NGO Maiti Nepal has a presence nearby, in the bordering town of Banbasa, as the borders of Gauriphanta and Kanchanpur are the most vulnerable transit points in the west. Shakti Samuha, WOREC, INSEC, RUDUK, Shanti Punasthapan Griha, Dalit Mahila Adhikar Manch, NEFIN, and Three Angels are also present, and work against human trafficking. The activities of these organizations include awareness, skills training and physical and social rehabilitation. In the western region, Tharu are vulnerable to girl and child trafficking due to poor education, poverty and lack of support after the practice of bonded labor was abolished. Child labor is also prominent amongst this group, with corresponding consequences for education drop out. As boys reach very early adolescence, they face both financial and social pressure to earn money.

Table 53. Socio-economic Profile of T8 District

| T8 District: Kailali | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Area ($Km^2$) | District Population | | | | VDCs | VDCs – Population (Total) | | | | |
| | Total | M | F | HH | | Total | M | F | HH | |
| 3,235 | 775,709 | 378,417 | 397,292 | 142,480 | 4: (Geta; Godawari; Malakheti; Sahajpur) | 67,049 | 29,350 | 37,699 | 12,965 | |
| | | | | | | | | | | |
| Agriculture (ha) | | Pasture | Forest | Community Forest | | Leasehold Forest | | | | Poverty Rate |
| Cultivated | Not Cultivated | (ha) | (ha) | Area (ha) | CFUGs | Area (ha) | Groups | HH | | |

Table 53. Socio-economic Profile of T8 District

| T8 District: Kailali | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 69,667 | 11,113 | 4,837 | 23,109 | 25,593 | 257 | | | | | 34% |

Notes: All figures in this and following table are from National population and Housing Census 2011 (NPHC 2011), November 2012;
VDCs are those through which transmission line passes or in which substations are located;
The poverty rate (rounded, below) is the headcount ratio, the proportion of the population that lives below the poverty line; at the time of the 2011 Census, an individual was considered poor is his/her per capital income was below NRs 19,261.

| **Economic Activity Performed** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Total population 10 years and above | Economically Active | | | | | | Not Economically Active | | Economic Activity Not Stated | |
| | Usually Active | | | | Not Usually Active | | | | | |
| | Employed | | Unemployed | | | | | | | |
| | Male | Female | Male | Female | Male | Female | Male | Female | Male | Female |
| 597100 | 155564 | 113616 | 2641 | 1187 | 9780 | 28053 | 113700 | 168640 | 1783 | 2136 |
| **Usual Activity Performed** | | | | | | | | | | |
| Total person | Own Agriculture | Wage/ Salary Earning | Own Non-Agricultural | Extended Economic | Seeking Job | House-hold Chores | Study | Non-activity | Not Stated | % Non-ag employ-ment |
| 597100 | 220473 | 104555 | 43953 | 38561 | 21054 | 201484 | 202303 | 56659 | 3920 | 49% |

Table 54. Sex of Household Heads for T8 District

| | Kailali | |
|---|---|---|
| | Totals | Percent |
| **Total** | 142,480 | 100.0% |
| Male | 107,351 | 75.3% |
| Female | 35,129 | 24.7% |

### 4.5.4 Cultural

No significant cultural resources have been identified within the T8 corridor.

## 4.6 T3

The T3 transmission line will connect the Tadekhani Substation with the proposed Kusma Substation. The preferred alignment was identified using a multi-criteria analysis that took into consideration technical, environmental, social and resettlement issues. Project details are shown in Table 55.

Table 55. Project T3 Details

| | Substations | | | Transmission line | |
|---|---|---|---|---|---|
| Reference | Name | Foot-print | Land acquisition, other | Description | Length |
| **T3** | Tadhekani | 100 x 100 m | Land to be acquired | 220 kV | 30 km<br>ROW = 30 m, 15 m from centerline |
| | Kusma | N/A | No land acquisition required | | |

The route map is shown on Figure 37.


**Figure 37. Project T3 Preferred Alignment**

It is understood that a construction access road will be needed along the length of the alignment (see Figure 38). Background information on existing environment of this road is not available however it is assumed that conditions along the road alignment are expected to be similar to those along the transmission line. The full ESIA should investigate the particulars of this alignment from an environmental and social perspective.


**Figure 38. Road from Beni to the Tadhekani Substation that will be Improved**

### 4.6.1 Physical

The physical environment for the T3 project is challenging, even though the route is relatively short. The route is located in three hilly and mountainous districts: Myagdi, Parbat, and Baglung. Numerous rivers dissect the landscape, and a large number of bridges are present. Climate zones range mostly from subtropical in the river valley bottoms to sub-alpine on the mountaintops, although the route alignment is mainly in the temperate zone.

Landslide and erosion potential for the project area is medium to high. Table 56 and Table 57 indicate the landslide potential due to earthquake and precipitation.

Table 56. Percent Distribution of Earthquake-Induced Landslide Potential

| District | Negligible (%) | Low (%) | Medium (%) | High (%) |
|---|---|---|---|---|
| Myagdi | 22.30 | 7.38 | 1.29 | 69.03 |
| Parbat | 0.83 | 17.50 | 2.39 | 79.28 |
| Baglung | 0.39 | 6.53 | 2.60 | 80.48 |

Source: Nepal Hazard Risk Assessment, Asian Disaster Preparedness Center, Norwegian Geotechnical Institute, and Centre for International Studies and Cooperation, undated, p. 45.

Table 57. Percent Distribution of Precipitation-Induced Landslide Potential

| District | Negligible (%) | Low (%) | Medium (%) | High (%) |
|---|---|---|---|---|
| Myagdi | 23.30 | 35.47 | 38.22 | 5.01 |
| Parbat | 2.55 | 36.88 | 54.78 | 5.80 |
| Baglung | 1.65 | 18.55 | 56.14 | 23.67 |

Source: Nepal Hazard Risk Assessment, Asian Disaster Preparedness Center, Norwegian Geotechnical Institute, and Centre for International Studies and Cooperation, undated, p. 45.
Landslide potential was considered of critical importance for physical impacts and mitigations.

### 4.6.2 Ecological

Despite its proximity to the mountains, most of the lands in the project districts are in the tropical and subtropical ecological zones, still with a significant percentage in the temperate zone, as shown in Table 58.

Table 58. Ecological Zones of Project T3

| District | Lower tropical (%) | Upper tropical (%) | Sub-tropical (%) | Temperate (%) | Sub-Alpine (%) | Alpine (%) |
|---|---|---|---|---|---|---|
| Myagdi | 0.1 | 17.5 | 28.0 | 21.1 | 17.8 | 1.6 |
| Parbat | 17.8 | 66.9 | 14.0 | 1.4 | | |
| Baglung | | 13.1 | 71.2 | 15.7 | | |

Source: Barnekow Lillesø, J-P., Shrestha, T. B., Dhakal, L. P., Nayaju, R. P., & Shrestha, R. (2005). The map of potential vegetation of Nepal: a forestry/agro-ecological/biodiversity classification system. Hørsholm: Center for Skov, Landskab og Planlægning/Københavns Universitet. (Development and Environment; No. 2/2005).

No national parks or other officially protected areas are traversed by the project route or occupied by its substations.

### 4.6.3 Socio-Economic

A socio-economic profile of the districts affected by T3 is presented in Table 60.

**Myagdi District**

Seven VDCs of Myagdi District will be affected by project activities, has very low population density, and a low sex ratio (80 men/100 women). Out-migration has not increased perceptibly over the past decade. There is a strong women-focused empowerment activity in the District, with some 120 microfinance institutions that primarily involve women, allowing for savings and income-generating activities.

**Parbat District**

The District has several rivers, the principal being Kali Gandaki, which flows along the western border and is a source of hydropower as well as sand and boulders. Project activities will take place in four VDCs

in the northwestern area of the District, which has remarkably low levels of increase in out-migration (39% for men from 2001 to2011, 3% for women – elsewhere in the country there has been an increase of 200-500%. With 32% of women who cannot read or write (and 15% men), it is essential that project activities include communication methods for encouraging employment and service provision which take that aspect into account. As can be seen from Table 59, women's ownership of fixed assets in these Districts is very low.

Table 59. Women's Land Ownership in T3 Area of Interest

| District | % of women* who own land | % of women* who own both house and land | % of women* owning neither house nor land | Substation |
|---|---|---|---|---|
| Myagdi | 4.50% | 7.30% | 65% | ✓ |
| Parbat | 7.30% | 8.50% | 58% | ✓ |
| Baglung | 4.30% | 5.90% | 61% | |
| * over 19 years of age | | | | |

Table 60. Socio-economic Profile of T3 Districts

| All T3 Districts: Baglung, Myagdi, Parbat | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Area ($Km^2$) | District Population | | | | VDCs | VDCs – Population (Total) | | | | |
| | Total | M | F | HH | | Total | M | F | HH | |
| 4,575 | 527,844 | 234,693 | 294,151 | 125,033 | 13 | 73,893 | 33,134 | 40,759 | 19,150 | |

| Agriculture (ha) | | Pasture | Forest | Community Forest | | Leasehold Forest | | | | Poverty Rate |
|---|---|---|---|---|---|---|---|---|---|---|
| Cultivated | Not Cultivated | (ha) | (ha) | Area (ha) | CFUGs | Area (ha) | Groups | HH | | |
| 80,533 | 40,629 | 83,142 | 192,516 | 55,380 | 1,076 | 4 | 2 | 14 | | 22% |

Notes: All figures in this and following table are from National population and Housing Census 2011 (NPHC 2011), November 2012;
VDCs are those through which transmission line passes or in which substations are located;
The poverty rate (rounded, below) is the headcount ratio, the proportion of the population that lives below the poverty line; at the time of the 2011 Census, an individual was considered poor is his/her per capital income was below NRs 19,261.

| Economic Activity Performed | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Total population 10 years and above | Economically Active | | | | Not Usually Active | | Not Economically Active | | Economic Activity Not Stated | |
| | Usually Active | | | | | | | | | |
| | Employed | | Unemployed | | | | | | | |
| | Male | Female | Male | Female | Male | Female | Male | Female | Male | Female |
| 203349 | 46272 | 63187 | 1471 | 325 | 5627 | 11090 | 32931 | 41485 | 408 | 551 |
| **Usual Activity Performed** | | | | | | | | | | |

Table 60. Socio-economic Profile of T3 Districts

| All T3 Districts: Baglung, Myagdi, Parbat | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Total person | Own Agriculture | Wage/ Salary Earning | Own Non-Agricultural | Extended Economic | Seeking Job | House-hold Chores | Study | Non-activity | Not Stated | % Non-ag employ-ment |
| 203349 | 98727 | 32881 | 24567 | 38780 | 8334 | 85143 | 61647 | 29584 | 960 | 51% |

Table 61. Sex of Household Heads for T3 Districts

| | Baglung | Myagdi | Parbat | Totals |
|---|---|---|---|---|
| **Totals** | 61,522 | 27,762 | 35,719 | 125,003 |
| Male | 35,737 | 15,686 | 21,252 | 72,675 |
| Female | 25,785 | 12,076 | 14,467 | 52,328 |
| **Percent** | | | | |
| Male | 58.1% | 56.5% | 59.5% | 58.1% |
| Female | 41.9% | 43.5% | 40.5% | 41.9% |

### 4.6.4 Cultural

No significant cultural resources have been identified within the T3 corridor.

## 4.7 T2'

The T2' 220 kV transmission line, approximately 30 km in length, will connect the Khimti Substation with the proposed Likhu hub Substation. The width of right of way for the transmission line is 30 meters. Other details are shown in Table 62. The preferred alignment was identified using multi-disciplinary expert analysis based on the multi-criteria the LRT model that took into consideration technical, environmental, social and resettlement resources. The line route avoids a number of environmental and social impacts by routing around many farmsteads and most homes, and minimizes intrusions into forested areas wherever feasible. The resulting alignment is illustrated in Figure 39. .

Table 62. Project T2' Details

| | Substations | | | Transmission line | |
|---|---|---|---|---|---|
| Reference | Name | Foot-print | Details | Details | Length (km) |
| T2' | New Khimti | N/A | No land acquisition | 220 kV double circuit ROW = 30 m | ~50 |
| | Likhu | 100 x 100m | Land has been acquired by IPP | | |

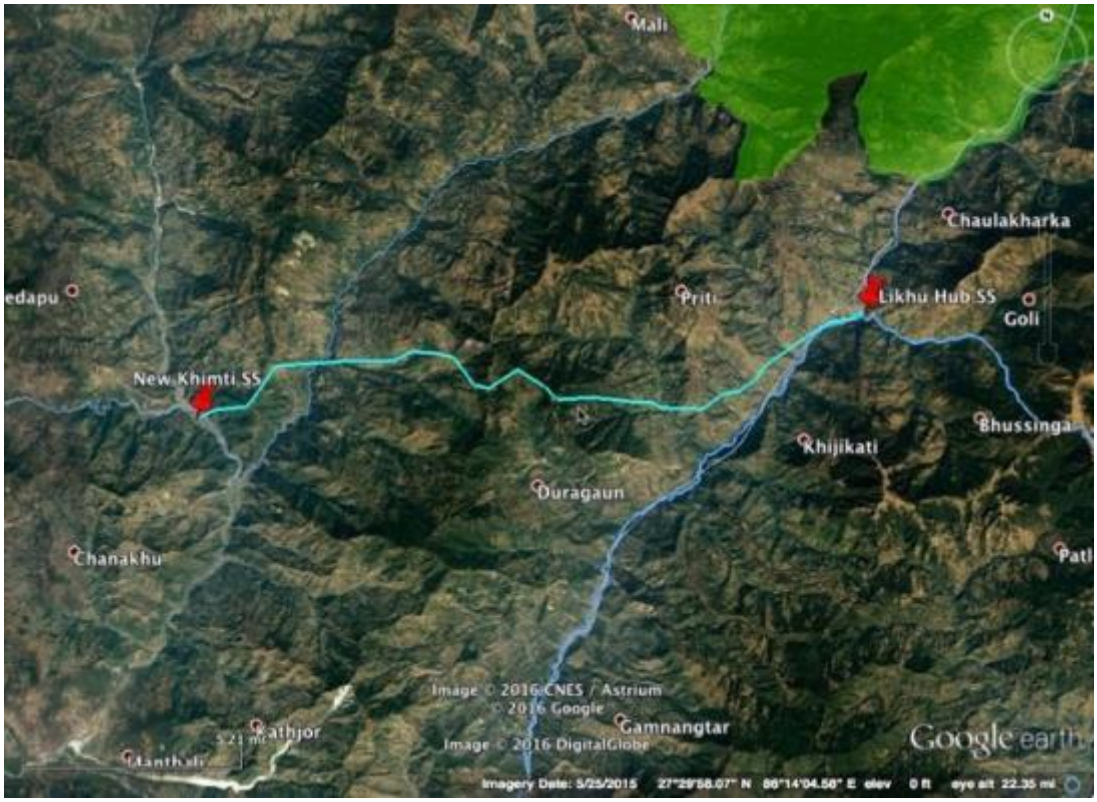


**Figure 39. T2' Transmission Line Preferred Alignment.** (Protected area is shown in green color)
Source: Tetra Tech 2016, based on Google Earth Pro Imagery

T2' is designed to serve up to 10 associated generation facilities as shown on Figure 40.

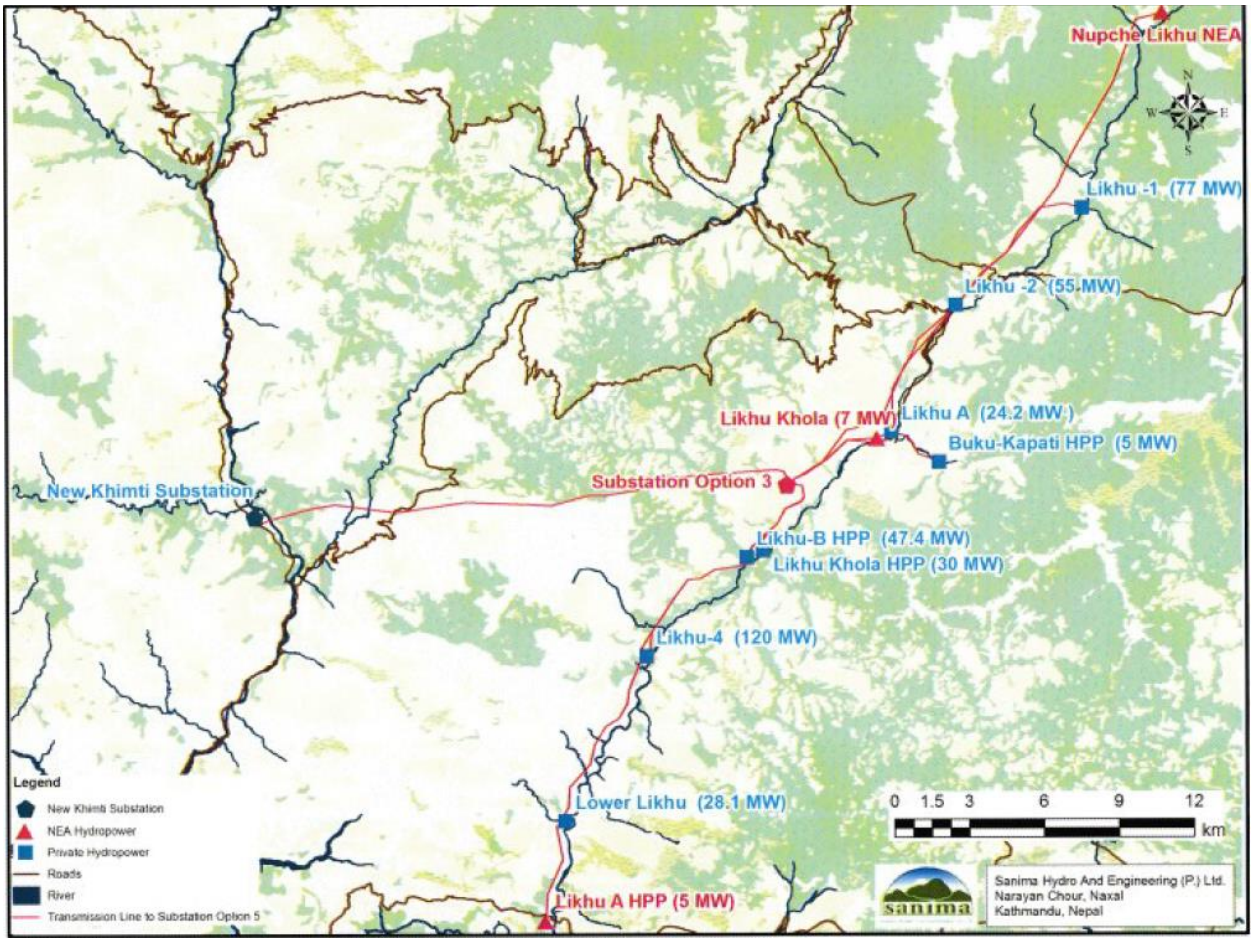


**Figure 40. Associated Facilities Served by T2'**
Source: Independent Power Producers' Association, Nepal (IPPAN)

### 4.7.1 Physical

The T2' project is located mostly in the Ramechhap District in the hilly sub-mountainous area of eastern Central Nepal, with a portion passing through the Dolakha District to the west. Although there is a lack of secondary information on air and water quality for the project area of interest, ambient conditions are expected to be within the permissible standards of Nepal as there are no industrial sources of pollution or large concentrations of population within the project area. Rivers are glacier fed. Precipitation is abundant. Erosion potential is expected to be rather high, along with the potential for earthquake-induced and precipitation-induced landslides, as indicated in Table 63 and Table 64.

Table 63. Percentage Distribution of Earthquake-Induced Landslide Potential in the T2' Project

| District | Negligible (%) | Low (%) | Medium (%) | High (%) |
|---|---|---|---|---|
| Ramechhap | 4.55 | 17.25 | 8.02 | 70.19 |
| Dolakha | 19.47 | 36.68 | 7.28 | 36.57 |
| Solukhumbu | 34.64 | 24.85 | 8.47 | 32.04 |

Source: Nepal Hazard Risk Assessment, Asian Disaster Preparedness Center, Norwegian Geotechnical Institute, and Centre for International Studies and Cooperation, undated, p. 45.

Table 64. Percentage Distribution of Precipitation-Induced Landslide Potential in T2' Project

| District | Negligible (%) | Low (%) | Medium (%) | High (%) |
|---|---|---|---|---|
| Ramechhap | 7.91 | 49.26 | 39.68 | 3.15 |
| Dolakha | 16.23 | 65.50 | 17.48 | 0.79 |
| Solukhumbu | 30.21 | 56.97 | 11.84 | 0.99 |

Source: Nepal Hazard Risk Assessment, Asian Disaster Preparedness Center, Norwegian Geotechnical Institute, and Centre for International Studies and Cooperation, undated, p. 45.

**Figure 41. Likhu River in Vicinity of T2' Project**
Source: SpotlightNepal.com Issue Name: Vol: 07 No. -9 Oct. 25- 2013 (Kartik 08, 2070)

### 4.7.2 Ecological

The ecological zonation of the route is shown in Table 65. Forest cover represents approximately half the area occupied by the T2' alignment, with agricultural activity occupying most remaining arable land. Rampant deforestation has become a problem in recent years, due to the abundance of species used by local inhabitants and medicinal herbs with commercial value.

Table 65. Ecological Zonation of T2' Project

| District | Upper tropical (%) | Sub-tropical (%) | Temperate (%) | Sub-Alpine (%) | Alpine (%) |
|---|---|---|---|---|---|
| Ramechhap | 18.0 | 42.1 | 21.0 | 6.7 | 3.6 |
| Dolkha | 1.9 | 26.2 | 28.5 | 16.6 | 0,4 |
| Solukhumbu | 0.7 | 9,3 | 20.6 | 15.5 | 28.3 |

Source: Barnekow Lillesø, J-P., Shrestha, T. B., Dhakal, L. P., Nayaju, R. P., & Shrestha, R. (2005). The map of potential vegetation of Nepal: a forestry/agro-ecological/biodiversity classification system. Hørsholm: Center for Skov, Landskab og Planlægning/Københavns Universitet. (Development and Environment; No. 2/2005).

**Biological Environment**

The T2' project area does not fall in a protected area (national park, wildlife sanctuary, buffer zone or conservation area) or an environmentally sensitive area. Forest vegetation consists of mainly Schima-Castonopsis, Hill Sal, Lower Temperate Oak, Chir Pine and Broadleaf forest. However, Khote salla (*Pinus roxburghii*) and Patula salla (*Pinus patula*) plantation forests are also found. The dominant species are few, forming a pure or mixed association of species. Due to the diversity of local topography and climate, the flora varies by location.

Scattered areas of red panda (Ailurus fulgens) habitat exist along one section of the route. The alignment bypasses those areas (see Figure 42).

Tree species are well represented by the deciduous and evergreen types. Major plants species found are Khote salla (*Pinus roxburghii*), Uttish (*Alnus nepalensis*), Chilaune (*Schima wallichii*), Bajh (*Quercus sps*), Sal (*Shorea robusta*), Kyamuno *(Cleistocalyx operculata),* and Patula salla *(Pinus patula)*. Likewise, the main NTFPs, including medicinal herbs, are Lokta (*Daphne bholua*), Argeli (*Edgeworthia gardeneri*), Kurilo (*Asparagus* sps), Nagbeli (*Lycopodium* sps), Chirayito (*Swertia chirayita*), and Amala (*Emblica officinalis*).

Mammals such as Salak (*Manis pantadactyla*), Barking deer (*Muntiacus munjak*), Jackal (*Canis aureus*), Leopard *(Panthera pardus*), Porcupine (*HystrixIndica*), Rhesus Monkey (*Macaca mulata*), Malsapro (*Martes flavigula*), and Squirrel (*Fuinambulas palmaurum*) are reported in the forest of the project-affected area.

Kalij (*Lephura leucomelana*), Common Myna (*Acridotheres tristis*), House Swift (*Apus affinis*), House Crow (*Corvussplendens*), Spotted Dove (*Streptopelia chinensis*), House Sparrow (*Passer domesticus*) and Cuckoo (*Eudyanamus sp*) are among the bird species reported in the project area.

***Protected Species of Flora and Fauna.*** Table 66 shows the status of protected flora and fauna according to GoN legislation, CITES appendixes, and IUCN Red List data.

Table 66. GoN Protected Flora and Fauna

| S. N. | Local Name | Scientific Name | IUCN Red list data | CITES category | GoN |
|---|---|---|---|---|---|
| 1 | Monkey | *Macaca mulatta* | LC | | |
| 2 | Fox | *Canis aureus* | LC | | |
| 3 | Leopard | *Panthera pardus* | NT | | |
| 4 | Chinese pangolin (Salak) | *Manis pantadactyla* | | II | Protected by National Park and Wildlife and Conservation Act, 2020 (1973) |
| 5 | Dumsi | *Hystrixindica* | LC | | |
| 6 | Kalij | *Lophura leucomelanos* | LC | | |
| 7 | Sal | *Shorea robusta* | LC | | Banned for commercial extraction, transportation and export |
| 8 | Walnut | *Juglans regia* | NT | | Banned for commercial extraction, transportation and export |

LC = Least Concern, NT = Not Threatened
Source: EIA Study Report of Khimti-Dhalkebar 220 kV Transmission Line Project, NEA-ESSD, 2005

**Ethno Botany/ Plant Resource Use Pattern**

The major timber yielding trees in the project area are Sal (*Shorea robusta*), Khote Salla (*Pinus roxburghii*) and Chilaune (*Schima wallichii*). Common fodder species are Kutmero (*Litsea monopetala*), Khaniyo (*Ficus semicordata*), Kavro (*Ficus lacor*), Dabdabe (*Garuga pinnata*), Tanki (*Bauhinia purpurea*), and Bamboo (*Dendrocalamus* sp.). Almost all the trees are used for firewood depending upon their availability.

Chiraito (*Swertia chiraita*), Lokta *(Daphne bholua*), Amala (*Emblica officinalis*), Kurilo (*Asparagus racemosus*), Bans (*Dendrocalamus* sp.), Argeli (*Edgeworthia gardeneri*), and Nagabeli (*Lycopodium* sp.) are the common NTFPs in the project area. They provide a source of income for the local people.

### 4.7.3 Socio-Economic

A socio-economic profile of the districts affected by T2' is presented in Table 68.

**Land Use**
Land use is a mixture of agricultural and forest. There are no urbanized areas, and all villages were bypassed during the linear routing process.

**Ramechhap**
The transmission line goes through the center, affecting 8 VDCs and 20 Wards. The District has low population density (128/square meter), and while there has been about 100% increase over the past decade in out-migration for women and men, only about 20% of households have an absent member. 43% of the women are unable to read and write (this is considered a high percentage) and nearly 25% of males. This necessitates that contractors include communication methods for encouraging employment and service provision which can address this issue.

**Dolakha**
Only two VDCs and five Wards at the southern tip of the District will be affected. Dolakha has a very low population density (83 persons/sq. km.). Nevertheless, there has been a huge increase in out-migration for both men (314%) and women (446%) over the decade 2001-2011, though actual numbers remain quite small. Nearly a quarter of men and 43% women are unable to read or write, and women's ownership of fixed assets is relatively low both in this District and in Morang (See Table 67).

Table 67. Women's Land Ownership in T2' Area of Interest

| District | % of women* who own land | % of women* who own both house and land | % of women* owning neither house nor land | Substation |
|---|---|---|---|---|
| Ramechhap | 7.90% | 5.60% | 58% | ✓ |
| Dolakha | 6.90% | 6.60% | 61% | |
| Solukhumbu | 9.20% | 8.34% | 62% | ✓ |

* over 19 years of age

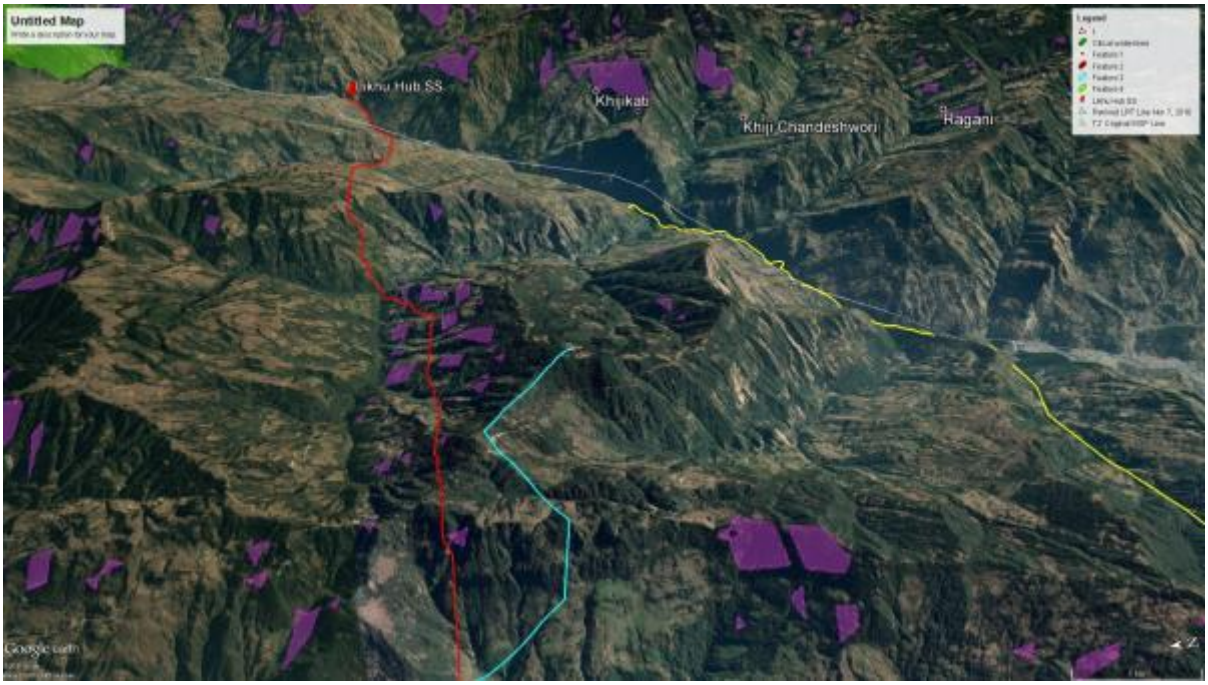


**Figure 42. Red Panda Habitat (purple) Avoided during Multi-Criteria Routing Exercise (light blue line). Alternative Alignment (red line) Rejected. View is East toward Likhu River Gorge.**

**Solukhumbu**

Only one VDC, 1 Ward will be affected in Solukhumbu District, which has very low population density at 31.76/sq. km. There has been some increase in out-migration, but the real numbers are small (125% men, 124% increase for women during 2001-2011).

Table 68. Socio-economic Profile of T2' Districts

| All T2' Districts: Ramechhap, Dolakha, Solukhumbu | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Area ($Km^2$) | District Population | | | | VDCs | VDCs – Population (Total) | | | |
| | Total | M | F | HH | | Total | M | F | HH |
| 7,050 | 495,089 | 231,589 | 263,500 | 113,383 | 11 | 35,305 | 17,413 | 17,892 | 8,204 |

| Agriculture (ha) | | Pasture | Forest | Community Forest | | Leasehold Forest | | | | Poverty Rate |
|---|---|---|---|---|---|---|---|---|---|---|
| Cultivated | Not Cultivated | (ha) | (ha) | Area (ha) | CFUGs | Area (ha) | Groups | HH | | |
| 90,908 | 46,455 | 35,592 | 265,860 | 85,291 | 765 | 3,427 | 616 | 5,569 | | 26% |

Notes: All figures in this and following table are from National population and Housing Census 2011 (NPHC 2011), November 2012;
VDCs are those through which transmission line passes or in which substations are located;
The poverty rate (rounded, below) is the headcount ratio, the proportion of the population that lives below the poverty line;

Table 68. Socio-economic Profile of T2' Districts

All T2' Districts: Ramechhap, Dolakha, Solukhumbu

at the time of the 2011 Census, an individual was considered poor is his/her per capital income was below NRs 19,261.

| Economic Activity Performed | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Total population 10 years and above | Economically Active | | | | | | Not Economically Active | | Economic Activity Not Stated | |
| | Usually Active | | | | Not Usually Active | | | | | |
| | Employed | | Unemployed | | | | | | | |
| | Male | Female | Male | Female | Male | Female | Male | Female | Male | Female |
| 393291 | 106617 | 120853 | 960 | 304 | 13723 | 18574 | 56465 | 72587 | 1391 | 1818 |

| Usual Activity Performed | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Total person | Own Agriculture | Wage/ Salary Earning | Own Non-Agricultural | Extended Economic | Seeking Job | House-hold Chores | Study | Non-activity | Not Stated | % Non-ag employ-ment |
| 393291 | 220458 | 56937 | 36509 | 57525 | 14315 | 132908 | 126076 | 38421 | 3210 | 43% |

Table 69. Sex of Household Heads for T2' Districts

| | Ramechhap | Dolakha | Solukhumbu | Totals |
|---|---|---|---|---|
| **Totals** | 43,910 | 45,688 | 23,785 | 113,383 |
| Male | 31,587 | 29,970 | 18,346 | 79,903 |
| Female | 12,323 | 15,718 | 5,439 | 33,480 |
| **Percent** | | | | |
| Male | 71.9% | 65.6% | 77.1% | 70.5% |
| Female | 28.1% | 34.4% | 22.9% | 29.5% |

### 4.7.4 Cultural

There are no significant religious/historic sites within the proposed TL route in Ramechhap district.

## 4.8 NR3

The NR3 transmission line connects the Inaruwa Substation (under construction) with the Ilam Substation (existing but would need to be expanded). The preferred alignment was identified using a multi-criteria analysis which took into consideration technical, environmental, social and resettlement issues. The preferred alignment is illustrated in Figure 43. .

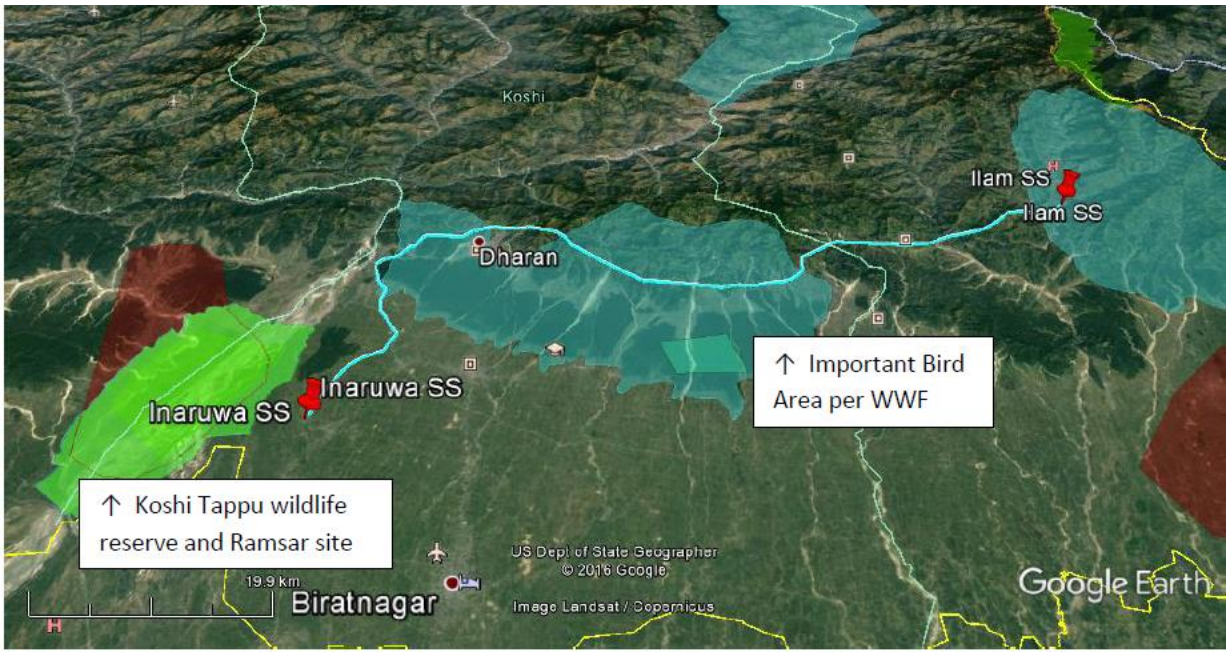


**Figure 43. NR3 Transmission Line Preferred Alignment and Wildlife Areas**
Source: Tetra Tech, 2016, based on Google Earth Pro imagery

### 4.8.1 Physical

This transmission line extends from Godak VDC of Ilam district to Bhokraha VDC of Sunsari District. The alignment route lies within Mechi and Koshi zone and passes through Ilam, Morang and Sunsari Districts. Municipalities along the TL are Ilam, Letand Bhogteni, Inaruwa whereas the VDCs along the TL are Godak, Siddhithumka, Danabari, Mahamai, Bajho, Sakfara, Tandhi, Jante, Letang Bhogteni, Kerabari, Yangshila, Panchakanya, Vishnupaduka, Barahchhetra, Mainamaini, Thokshila, Mahendranagar, Prakashpur, Singiya, Dumraha, Bhokraha.

**Geology**
The proposed TL mainly passes through hill and Siwalik regions. The hill region comprises transported deposits of conglomerate rocks. Common rocks found within community forest area are mudstone, sandstone, and quartzite. The zone is developed up to the Main Central Thrust. At the river bank, there is a recent alluvial deposit composed of boulders, cobbles, and gravel with sandy mixture.

**Landslide, Erosion and Slope Stability**
Different forms of soil erosion such as slope wash, mass fall, sheet erosion and rill erosion are common types of erosion on sloping terraces. Land instability in steeper sections of hills is a general problem and the topsoil is readily washed away by heavy rain, even on gentle slopes. Large landslides were not

observed, but there are ample small landslides in lower hill areas due to weak geomorphology. The landslide potential is not shown as particularly high, but due to intensive utilization of slopes, deforestation, and other factors, caution regarding slope stability and erosion, especially along ridge lines, is still warranted. See Table 70 and Table 71.

Table 70. Percentage Distribution of Earthquake-Induced Landslide Potential for NR3 Project

| District | Negligible (%) | Low (%) | Medium (%) | High (%) |
|---|---|---|---|---|
| Ilam | 87.44 | 12.56 | | |
| Morang | 99.96 | 0.04 | | |
| Sunsari | 93.89 | 6.11 | | |

Source: Nepal Hazard Risk Assessment, Asian Disaster Preparedness Center, Norwegian Geotechnical Institute, and Centre for International Studies and Cooperation, undated, p. 45.

Table 71. Percentage Distribution of Precipitation-Induced Landslide Potential in NR3 Project

| District | Negligible (%) | Low (%) | Medium (%) | High (%) |
|---|---|---|---|---|
| Ilam | 2.98 | 19.75 | 53.14 | 24.12 |
| Morang | 59.19 | 24.36 | 9.70 | 6.75 |
| Sunsari | 67.88 | 24.24 | 5.69 | 2.19 |

Source: Nepal Hazard Risk Assessment, Asian Disaster Preparedness Center, Norwegian Geotechnical Institute, and Centre for International Studies and Cooperation, undated, p. 45.

**Major River Basin Drainage and Hydrology**

The *Mai khola, Mawa Khola, Bakraha Khola, Chisang Khola, Lohandra Khola Ratuwa Khola Sunsari Khola, Koshi rivers* are some of the main rivers and streams within the proposed TL route area. These rivers and streams have expanded laterally in the flat plain area, meandering and braiding with heavy sediment loads, and are of narrow in the hill region. During rainfall, these rivers carry significant amounts of coarse debris, which causes a high rate of sedimentation, leading to the rapid rise of river beds.

### 4.8.2 Ecological

**Biological Environment**

The proposed project area does not fall in a protected area (national parks, wildlife sanctuary, buffer zone or conservation area) or an environmentally sensitive area (if the option II route is avoided in Sunsari and Udaypur districts, which passes through the Koshi Tappu Wildlife Reserve).

**Forest Types**

The proposed TL route area passes through the sub-tropical forest of Sal (*Shorea robusa*) species, where associated Asna (*Terminalia alata*), Karma (*Adina cordifolia*), Tatari (*Dylenia Pentagyna*) Botdhairo (*Lagerstroemia parviflora*), Latahar (*Artocarpus chaplasha*) Kuinjal (*Bischofia javanica*) Barro (*Terminalia*

*bellirica*), Hallude (*Lannea coromandilica*), Bhalayo (*Semicarpus anacardium*) Jamun (*Syzygium cumini*), Mainakath (*Tetrameles nufiflora*), and Karma (*Adina cardifolia*) are found. Along the river banks, the dominant species include Simal (Bombax ceiba), Pani Saj (*Terminilia Arjuna*), Kutmiro (*Letsia Monopetala*), and Seto siris (*Albizia Procera*) forest.

An ecological zonation of the NR3 project is shown in Table 72. The decidedly tropical nature of the environmental setting is due to the location of two districts, Morang and Sunsari, in the Tarai.

Table 72. Ecological Zonation of NR3 Project

| District | Lower tropical (%) | Upper tropical (%) | Sub-tropical (%) | Temperate (%) | Sub-Alpine (%) | Alpine (%) |
|---|---|---|---|---|---|---|
| Ilam | 15.5 | 33.5 | 40.1 | 10.6 | 0.3 | |
| Morang | 80.9 | 11.5 | 7.4 | 0.2 | | |
| Sunsari | 86.6 | 7.8 | 2.0 | | | |

**Plants of Conservation Significance**

Open grazing, forest fire, fuel wood collection, fodder lopping, and illegal felling of forest products are the main conservation threats to the project area. These threats have created pressure to conserve tree species like Asna (*Terminalia alata*), Khair (*Accacia catechu*), Simal (*Bombax ceiba*), Satisal (*Dalbergia latifilia*), Kusum (*Schleichera oleosa*), Tatari (*Dilenaia pentagyna*), Champ (*Michelia champaca*), Sandan (*Desmodium oojeeinense*), and Palans (*Butea monosperma*). Non-timber forest products like Bel (*Aegle marmelos*), Kurilo (*Asparagus officinalis*), Sarpaghanda (*Rauvolfia serpentine*), Gurjo (*Tinospora cordifolia*), Tama Bans (*Dendrocalamus hamiltonii*), Tarul (*Dioscorea deltoidea*), and Ban lasun (*Allium wallichii*) are also threated due to unsustainable harvest practices, forest fires and grazing. Table 73 shows some of the protected plant species found in the area and their conservation status.[183]

Table 73. Protected Plant Species

| | Local Name | Endangered Categories | | |
|---|---|---|---|---|
| | | GoN | CITES | IUCN |
| *Shorea robusta* | Sal | *** | | |
| *Acacia catechu* | Khyar | *** | | T |
| *Bombax ceiba* | Simal | *** | | |
| *Alstonia scholaris* | Chhatiwan | | | R |
| *Orxylum indicum* | Tatelo | | | V |
| *Butea monosperma* | Palans | | | E |
| *Michelia champaka* | Champ | *** | | |
| *Dalbergia latifolia* | Satisal | *** | | |

[183] Sources: "IEE Study Report of Kabeli Corridor 132 kV Transmission Line Project," NEA-ESSD, 2010
"EIA study report of East West Highway (EWH) (Nadaha)- Koshi Bridge (Chatara) East West Highway," Department of Roads, 2013

Table 73. Protected Plant Species

| | Local Name | Endangered Categories | | |
|---|---|---|---|---|
| | | GoN | CITES | IUCN |
| *Rauwolfia serpantina* | Sarpagandha | | II | E |
| *Cinnamomum glaucescens* | Sugandakokila/Malagiri | ** | | |
| *Dioscorea deltoidea* | Bhaykur/ Ban tarul | | II | |
| *Crataeva unilocularis* | Siplikan | | | R |
| *Elaeocarpus sphaericus* | Rudrakshya | | | V |

IUCN Definition: E=Endangered; V=Vulnerable; R=Rare; T=Threatened
CITES Category: I = Species threatened with extinction; II = Species not yet threatened, but could become endangered if trade is not controlled; III = Species protected by individual countries within their borders and for which the cooperation of other convention signatories is sought.
Protected plant species in Nepal under the Forest Act, 1993
* medicinal herbs banded for collection, use, sale, distribution, transportation and export
** medicinal plants banded for export outside the countries in crude form
*** Trees banded for transportation, export and felling

**Wildlife**[184]

*Mammals:* Ban Biralo, Bandel, Chittal, Bwanso, Kharayo, Syal, Dhedu, Baandar, Lokharke, Nyaurimusa, Chamero, Mriga, Jarayo, Chituwa, Dumsi, Salak, Hatti, Kala, Malsapro, Khekari, Nigale chituwa, and others.

*Reptiles:* Snake (Goman, Dhaman, Karet, Sirise, Harreu, Ajingar, Dhode, Ganjuwali, Hararu/bagale, Sun Gohoro (Thoke), Kalo Gohoro, Chheparo, Mausuli, and others.

*Birds:* Jureli, Lahache, Suga, Mayur, Ban Kukhura, Theuwa (Nilkantha), Dangre, Koili, Giddha, Bhangera, Dhukur, Kaag, Chil, Bakulla, Maina, Kalij, Latokosero, Sarau, Bhadrase, Lahache, Chibe, Matikore, Gauthali, Haleso, Kuthruke, Ranichari, Huchil, Dhanesh, Dhobi Chara, Hongrayo, Fiste, Gidda, and Bhaykur.

Table 74. Protected Fauna

| Genus Species | Type | English Name | Endangered Categories | |
|---|---|---|---|---|
| | | | CITES | IUCN |
| *Semnopithecus schistaceus* | Mammals | Nepal Grey Langur | I | |
| *Felis chaus* | Mammals | Jungle cat | II | |
| *Pteropus giganteus* | Mammals | Indian flying fox | II | |
| *Manis crassicaudata* | Mammals | Indian Pangolin | II | EN |
| *Macaca mulatta* | Mammals | Rhesus Macaque | II | V |

[184] IEE Report of Rani, Jamara, Kulariya Irrigation Project, Kailali, Department of Irrigation, 2010

Table 74. Protected Fauna

| Genus Species | Type | English Name | Endangered Categories | |
|---|---|---|---|---|
| | | | CITES | IUCN |
| *Ratufa bicolor* | Mammals | *Black Giant Squirrel* | II | E |
| *Varanus bengalensis* | Sauria | Bengal Lizard | I | |
| *Varanus flavescens* | Sauria | Golden Monitor | I | |
| *Python molurus* | Serpentes | Asiatic Rock Python | I | E |
| *Ptyas mucosa* | Serpentes | Oriental Rat Snake | II | |
| *Naja* | Serpentes | Spectacled Cobra | II | |
| *Hoplobatrachus tigerinus* | Amphibia | Indian Bull Frog | II | R |
| *Euphlyctis hexadactylus* | Amphibia | Indian Green Frog | II | V |

Key: See **Table 73** Sources: "IEE Study Report of Kabeli Corridor 32 kV Transmission Line Project," NEA-ESSD, 2010

### 4.8.3 Socio-Economic

**Ilam**

This line affects 8 VDCs and 17 Wards. There have been significant increases in out-migration (317% increase for men during 2001-2011, 320% for women), which has significant implications for the vulnerability of resident household members. About 25% of women are unable to read and write, and 14% of men.

**Sunsari**

The proposed transmission line will run through the north-central area of the District covering 9 VDCs and 29 Wards. The District has seen sizeable increases in populations in the labor market (302% increase for men, 244% for women during 2001-2011). Women ownership of fixed assets is higher than many other districts, but still not significant. With 22% of men and 38% of women unable to read and write, outreach and awareness of project opportunities will require appropriate communication methods.

**Morang**

Project activities will affect 5 VDCs and 18 wards in the northern part of the District. Literacy levels are roughly comparable with those of Sunsari District. In all three of these Districts, rates of women's ownership of fixed assets are relatively higher than elsewhere in Nepal, indicating the relatively better-off status of women in the East, though ownership is still heavily skewed in favor of men (see Table 75).

Table 75. Women's Land Ownership in NR-3 Area of Interest

| District | % of women* who own land | % of women* who own both house and land | % of women* owning neither house nor land | Substation |
|---|---|---|---|---|
| Ilam | 6.80% | 5.90% | 58% | ✓ |
| Morang | 9.40% | 12.20% | 50% | |
| Sunsari | 9.80% | 12.14% | 49% | ✓ |
| * over 19 years of age | | | | |

Table 76. Socio-economic Profile of NR3 Districts

| All NR3 Districts: Ilam, Morang, Sunsari | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Area ($Km^2$) | All NR3 District Population | | | | VDCs | | VDCs – Population (Total) | | | |
| | Total | M | F | HH | | | Total | M | F | HH |
| 4,815 | 2,019,111 | 979,067 | 1,040,098 | 440,906 | 15 | | 335,962 | 152,894 | 183,068 | 74,170 |
| | | | | | | | | | | |
| Agriculture (ha) | | Pasture | Forest | Community Forest | | Leasehold Forest | | | | Poverty Rate |
| Cultivated | Not Cultivated | (ha) | (ha) | Area (ha) | CFUGs | Area (ha) | Groups | HH | | |
| 226,629 | 43,472 | 10,781 | 173,813 | 58,822 | 296 | 0 | 0 | 0 | | 14% |

Notes: All figures in this and following table are from National population and Housing Census 2011 (NPHC 2011), November 2012;
VDCs are those through which transmission line passes or in which substations are located;
The poverty rate (rounded, below) is the headcount ratio, the proportion of the population that lives below the poverty line; at the time of the 2011 Census, an individual was considered poor is his/her per capital income was below NRs 19,261.

| **Economic Activity Performed** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Total population 10 years and above | Economically Active | | | | | | Not Economically Active | | Economic Activity Not Stated | |
| | Usually Active | | | | Not Usually Active | | | | | |
| | Employed | | Unemployed | | | | | | | |
| | Male | Female | Male | Female | Male | Female | Male | Female | Male | Female |
| 1,608,356 | 461,331 | 302,492 | 9,553 | 4,383 | 21,348 | 62,725 | 267,923 | 471,075 | 3,782 | 3,742 |
| **Usual Activity Performed** | | | | | | | | | | |
| Total person | Own Agriculture | Wage/ Salary Earning | Own Non-Agricultural | Extended Economic | Seeking Job | House-hold Chores | Study | Non-activity | Not Stated | % Non-ag employ-ment |
| 1,608,356 | 444,025 | 332,789 | 182,101 | 159,857 | 57,237 | 526,323 | 453,680 | 218,268 | 7,525 | 62% |

| Table 77. Sex of Household Heads for NR3 Districts | | | | |
|---|---|---|---|---|
| | Ilam | Morang | Sunsari | Totals |
| **Totals** | 64,502 | 213,997 | 162,407 | 440,906 |
| Male | 51,777 | 159,694 | 120,148 | 331,619 |
| Female | 12,725 | 54,303 | 42,259 | 109,287 |
| **Percent** | | | | |
| Male | 80.3% | 74.6% | 74.0% | 75.2% |
| Female | 19.7% | 25.4% | 26.0% | 24.8% |

### 4.8.4 Cultural

The NR3 project traverse's numerous districts, important cultural features are outlined in Table 78.

| Table 78. Important Cultural Sites Along the Proposed NR3 Route | |
|---|---|
| District | Site |
| NR3 | |
| Ilam | **Maibeni:** located at the confluence of the Mai Khola and Jogmai rivers, 3 km east of Ilam Bazar, this is a famous religious site |
| | **Siddhi Thumka:** located at an altitude of 2,100 m in Siddhi Thumka VDC, this site is famous for its sunrise and sunset views, and sightseeing of the Siwalik and Mahabharat mountain ranges. |
| | **Mangmalung:** located between Banjho and Ibhang VDC, this is a place of religious importance for the Kirant religious groups. |
| Morang | **Rajarani Pokhari (Dhimal Durbar):** located in Bhogteni VDC, this is a pond of historic importance and the location of King Dhimal's palace. |
| | **Sapta Kanya Gupha:** located in Yangshila VDC-1, this is a cave of religious importance, and could be an attractive tourist destination. |
| Sunsari | **Barah Chhetra Mandir:** located in Barahchhetra VDC-2, this is a famous pilgrimage site for Hindus. |
| | **Panchanakya Temple:** located in Panchakanya VDC, this is a religious site. |
| | **Ramdhuni:** located at 7 km north of Inaruwa Municipality, this is a famous religious pilgrimage site, surrounded by dense forest. |
| | **Bishnupaduka:** located 4 km north west of Dharan Municipality, this is a famous religious site. |
| | **Bhedetar:** located at 17 km north of the Dharan sub-metropolitan area near the border of Sunsari and Dhankuta districts, this is a sightseeing destination. |
| | **Thingedhunga:** located in Panchakanya VDC-5, Thingabari, this is a place of historic importance, providing evidence on King Sen and Queen Kirant. |
| | **Koshi Tappu Wildlife reserve:** located in West Sunsari district along the Koshi River, this is an International Ramsar site: a bird sanctuary area that is also famous for its wild buffalo. |

## 4.9 NR4

The NR4 route is an existing line and set of substations, which would be upgraded with the addition of a second 132 kV line on the existing towers. No new land acquisition is required. See Figure 44. for a depiction of the alignment.

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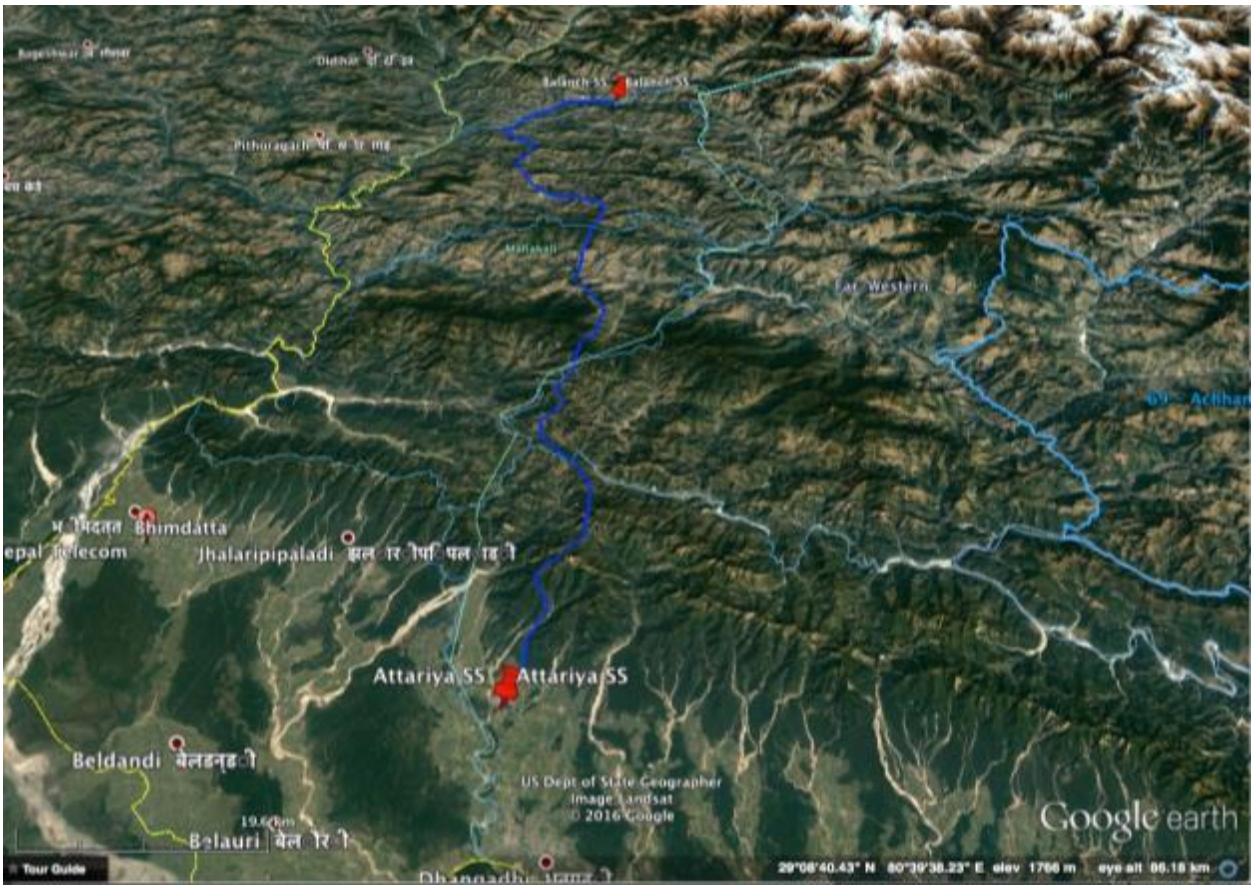


**Figure 44. NR4 Existing Line Alignment (dark blue). Light blue lines are district boundaries**

### 3.9.1 Physical

Table 79. Details of NR4 Transmission Line and Substations

| | Substations | | | Transmission line | |
|---|---|---|---|---|---|
| Reference | Name | Foot-print | Land acquisition, other | Description | Length |
| NR4 | Balanch | N/A | No new land acquisition | 132 kV single circuit addition to existing double circuit towers, currently strung with one circuit. | 104 km<br>ROW = 18 m, 9 m from centerline. ROW acquisit may not be complete. |
| | Attariya | 100 x 100 m | Land has been acquired by IPP | | |

There are no erosion and landslide issues because there will be little or no new construction along the route and only temporary activity stringing the line. Erosion and landslide information is presented for the districts in which the substations are located. See Table 80 and Table 81.

Table 80. Percentage Distribution of Earthquake-Induced Landslide

| District | Negligible (%) | Low (%) | Medium (%) | **High (%)** |
|---|---|---|---|---|
| Darchula | 8.85 | 23.00 | 2.63 | 64.55 |
| Kailali | 74.27 | 25.73 | | |

Table 81. Percentage Distribution of Precipitation-Induced Landslide

| District | Negligible (%) | Low (%) | Medium (%) | High (%) |
|---|---|---|---|---|
| Darchula | 12.48 | 26.40 | 46.29 | 14.70 |
| Kailali | 37.11 | 34.47 | 21.20 | 7.22 |

### 4.9.2 Ecological

The proposed project area does not fall within in protected area (national park, wildlife sanctuary, buffer zone or conservation area) or an environmentally sensitive area. Since the climate of the project area varies from tropical to sub-tropical and temperate, its vegetation also varies accordingly.
Ecological zonation of the two districts in which the substations are located and in which the only construction impacts are likely is shown in Table 82.

Table 82. Ecological Zonation of NR4 Project

| District | Upper tropical (%) | Sub-tropical (%) | Temperate (%) | Sub-Alpine (%) | Alpine (%) |
|---|---|---|---|---|---|
| Darchula | 4.7 | 19.8 | 22.2 | 20.5 | 15.3 |
| Kailali | 1.9 | 26.2 | 28.5 | 16.6 | 0,4 |

As can be seen from the table, there are significant ecological differences in the mountainous Darchula district, in which the Balanch substation is located, and the Tarai area of the Kailali district, in which the Attariyah substation is located. These differences will be addressed in the environmental impact assessment.

According to OMCN,[185] there are still trees to be cut within the ROW. Since the project has taken several years, there are trees that were originally small enough to leave, but they have since grown larger. Approximately 150 hectares were cleared and nearly 11,000 trees cut for the original line, but the status of land and trees is currently unclear. Land has been acquired for tree replanting, based on the number of trees that were cut down from ROW. This information will be verified and supplemented by field visits during the full ESIA phase.

### 4.9.3 Socio-Economic

**Figure 45. Transmission Towers and Trees along the Existing NR4 Project Route**

**Bataidi District**

Baitaidi, with 13 VDCs affected by project activities, has considerable forest cover, with a large number of CFUGs, representing over 70% of the district population. Health and sanitation are key issues for the district, with an estimated 60% of households without toilets. Only two VDCs have been declared open-defecation free (ODF). Women face significant challenges in the Far Western Region, where there are high levels of poverty, and significant numbers of lower-caste Dalits that face continuing discrimination. The situation is exacerbated by poor accessibility and limited infrastructure in the remotest parts of the Region.

**Dadeldhura District**

Four VDCs will be affected by project activities. Subsistence agriculture farming and small-scale livestock represent the major livelihoods, but owing to low productivity and poor accessibility, food security is a significant challenge in the District. There are several NGOs in the area conducting advocacy work for protection of women's rights. Indigenous peoples needed to be focused on as they enter the cash economy more fully, and need to be protected against speculative intrusions into their traditional landholdings. The provision of some forestry lands to Dalit women under 40-year leasehold agreements has improved their livelihoods with legal access to forest products.

[185] Minutes of meeting with OMCN project manager, Tetra Tech 15 November 2016

Table 83. Women's Ownership of Fixed Assets in Affected NR4 Districts

| District | Women who own land (%) | Women who own both house and land (%) | Women owning neither house nor land (%) | Planned Substation |
|---|---|---|---|---|
| Darchula | 0.70 | 1.00 | 66.00 | ✓ |
| Baitadi | 0.50 | 0.80 | 64.00 | |
| Dadeldhura | 1.10 | 1.40 | 67.00 | |
| Doti | 1.00 | 1.20 | 70.00 | |
| Kailali | 3.80 | 4.90 | 58.00 | ✓ |

**Darchula District**

Because of the extreme variation in altitude and the consequent variation in climate, this region is endowed with excellent habitats for diverse flora and fauna as well as socioeconomic and cultural diversity. The District, with three VDCs affected by the project, has high poverty levels. With significant forest cover, there are many active CFUGs, with several lead by women.

**Doti District**

As with other parts of the Far Western Region, a large part of the District is covered by forests, some 23% of which is managed by CFUGs, together with a small percentage as leasehold. Although project activities will affect only two VDCs with about 3% of the district population, there are women's issues common across the district, particularly gender-based violence and domestic violence, gender-based discrimination in education, in household chores and in nutrition, as well as differential social and cultural norms. In the majority of households in Doti (97%), women do not own land or their house, although some 36% of households are headed by women. Chaupadi is prevalent in the District, whereby women are considered untouchable during the first five days of their menstrual cycle and must remain separate from others in many aspects of daily life, often in a dedicated shed outside the household; half of women aged 15-49 report experiencing Chaupadi. While the Haliya system of bonded agriculture has been abolished, Haliya families remain vulnerable in their rehabilitation away from their homes on landowner properties.

**Kailali District**

Project activities for NR4 will cover four VDCs in addition to the seven VDCs in the tarai region. See description above.

Table 84. Socio-economic Profile of NR4 Districts

| All NR4 Districts: Bataidi, Dadeldhura, Darchula, Doti, Kailali | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Area ($Km^2$) | District Population | | | | VDCs | VDCs – Population (Total) | | | |
| | Total | M | F | HH | | Total | M | F | HH |
| 10,639 | 1,513,721 | #VALUE! | 790,484 | 280,774 | 26 | 160,529 | 73,138 | 87,391 | 30,002 |

| Agriculture (ha) | | Pasture | Forest | Community Forest | | Leasehold Forest | | | | Poverty Rate |
|---|---|---|---|---|---|---|---|---|---|---|
| Cultivated | Not Cultivated | (ha) | (ha) | Area (ha) | CFUGs | Area (ha) | Groups | HH | | |
| 170,936 | 54,009 | 99,168 | 441,958 | 149,393 | 1,321 | 1,945 | 478 | 4,796 | | 41% |

Notes: All figures in this and following table are from National population and Housing Census 2011 (NPHC 2011), November 2012;
VDCs are those through which transmission line passes or in which substations are located;
The poverty rate (rounded, below) is the headcount ratio, the proportion of the population that lives below the poverty line; at the time of the 2011 Census, an individual was considered poor is his/her per capital income was below NRs 19,261.

| **Economic Activity Performed** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Total population 10 years and above | Economically Active | | | | | | Not Economically Active | | Economic Activity Not Stated | |
| | Usually Active | | | | Not Usually Active | | | | | |
| | Employed | | Unemployed | | | | | | | |
| | Male | Female | Male | Female | Male | Female | Male | Female | Male | Female |
| 1128900 | 284014 | 278211 | 3863 | 1623 | 23662 | 51198 | 206040 | 273103 | 3068 | 4120 |

| **Usual Activity Performed** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Total person | Own Agriculture | Wage/ Salary Earning | Own Non-Agricultural | Extended Economic | Seeking Job | House-hold Chores | Study | Non-activity | Not Stated | % Non-ag employ-ment |
| 1128900 | 498524 | 187132 | 125488 | 164720 | 43236 | 451753 | 377850 | 126168 | 7189 | 51% |

Table 85. Sex of Household Heads for NR4 Districts

| | Bataidi | Dadeldhura | Darchula | Doti | Kailali | Totals |
|---|---|---|---|---|---|---|
| **Totals** | 45,191 | 27,045 | 24,618 | 41,440 | 142,480 | 280,774 |
| Male | 35,716 | 19,221 | 20,065 | 26,566 | 107,351 | 208,919 |
| Female | 9,475 | 7,824 | 4,553 | 14,874 | 35,129 | 71,855 |
| **Percent** | | | | | | |
| Male | 79.0% | 71.1% | 81.5% | 64.1% | 75.3% | 74.4% |
| Female | 21.0% | 28.9% | 18.5% | 35.9% | 24.7% | 25.6% |

### 4.9.4 Cultural

No information on cultural resources along the NR4 corridor was available as this writing.

## 4.10 Climate Change Issues that Could Affect a Routing Decision

There are two perspectives to consider climate change for the MCC transmission line program: 1) the effect of transmission lines have on the production of greenhouse gases (GHG) that would contribute to climate warming, and 2) the effect of climate change on the transmission lines.

### 4.10.1 Greenhouse Gas (GHG) Emissions

Materials used in the construction of transmission lines (aluminum, concrete, other metals, other building materials) have embodied emissions as a result of the energy used to produce them.[186] In addition to the embodied emissions, transmission line construction can also contribute emissions from construction equipment, energy in land clearing, sulfur hexafluoride ($SF_6$, used in insulation and current interruption applications), and nitrous oxide ($N_2O$) corona effects created by very high-voltage transmission lines. $SF_6$, and $N_2O$ are GHGs having 22,800 and 298 GWP (global warming potential)[187]. Given the size of the MCC program it is likely that calculation of embodied and direct GHG emissions will need to be computed in the ESIA to determine the full climate change impacts of the program.

In addition to the direct and embodied GHG emissions from construction of the Tx lines, the projects may have impacts associated with the clearance of the ROW under the Tx lines in forested areas. It has been estimated that the average annual $CO_2e$ sequestration in the CHAL amounts to about 13t $CO_2e$/ha.[188] The same source estimated average biomass residing in different types of forests as ranging from 145 to 342 t/ha. If a significant amount of this resource is burned it would release significant amounts of carbon into the atmosphere.

[186] Madrigal, Marcelino and Randall Spalding-Fecher 2010 “Impacts of Transmission and Distribution Projects on Greenhouse Gas Emissions: Review of Methodologies and a Proposed Approach in the Context of World Bank Lending Operations” Energy and Mining Sector Board Discussion Paper No. 21, Word Bank

[187] IPCC 2007 “Fourth Assessment Report: Climate Change 2007” Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge.

[188] Subedi, B.P., K. Gauli, N.R. Joshi, A. Pandey, S. Charmakar, A., A. Poudet, M.R.S. Murthy, H. Glani, and S.C. Khanal. 2015 “Forest Carbon Assessment in Chitwan-Annapurna Landscape.” Study Report, WWF Nepal Hariyo Ban Program, Balutwatar, Kathmandu, Nepal.

As of 2010, Nepal's GHG emissions make up less than 0.1% of global emissions[189]. With its current policies, Nepal's GHG emissions are expected to increase to between 50–53 $MtCO_2e$ by 2030 (an increase of 55–66% compared to 2010 levels). Even with this increase, the country's per capita emissions would only grow from 1.2 tCO2e/cap as of 2010 to 1.5–1.6 tCO2e/cap by 2030, still far below the 2012 world average of 7.6 $tCO_2e$/cap (JRC, 2016).[190]

Up to 25% of global carbon emissions is due to deforestation.[191] Although deforestation occurs rampantly in the national forest of Nepal the community forests have successfully managed a reforestation in those areas they control, particularly in the hills. A recent report[192] stated: "the community forests, mainly in the hills, are well managed with positive economic, social and environmental outcomes." The routing process included an effort to avoid going through forests since the right-of-way areas under the lines will require removal of the existing trees, thereby potentially reducing the carbon-capture capability of the community forests.

The projects also will have positive climate change effects by reducing emissions from diesel back-up generators in Nepal due to the provision of more reliable electrical power resulting from hydropower generators. There may also be some reduction in the emissions from coal-fired power plants in India once Nepalese hydropower electricity is imported there.

### 4.10.1 Effects of Climate Change on the Transmission Line Program

Available studies of the effects of climate change in Nepal on electric facilities are limited. A 2011 study of the Khimti 1 Hydropower Scheme[193] identified several potential risks for the hydropower plant, some of which are either directly or indirectly applicable to the MCC transmission line program, such as:

- Risk of catastrophic flooding from GLOFs (Glacial Lake Outburst Floods) caused by the formation of unstable glacial lakes that eventually overflow or burst due to continued warming. This would threaten any transmission lines that were downstream of the GLOF events unless they were well out of the GLOF flood plain.

[189] Nepal contributes 37.37 $MtCO_2e$ per year compared to world emissions of 42,669.72 $MtCO_2e$ per year (not including land use change and forestry). https://en.wikipedia.org/wiki/List_of_countries_by_greenhouse_gas_emissions Accessed 16 November 2016.

[190] http://climateactiontracker.org/countries/nepal.html; Accessed 14 November 2016

[191] IPCC 2001 "Climate change 2001: the scientific basis. Contribution of Working Group I to the IPCC Third Assessment Report." Cambridge University Press, Cambridge.

[192] Paudel, N.S., Khatri, D.B., Khanal, D.R. and Karki, R. 2013. The context of REDD+ in Nepal: Drivers, agents and institutions. Occasional Paper 81. CIFOR, Bogor, Indonesia.

[193] Stenek, Connell, Firth, Colley 2011 "Climate Risk Case Study - Khimti 1 Hydropower Scheme, Himal Power Limited – NEPAL" International Finance Corporation

- Risk of completely interrupted energy from hydro plants that were damaged or destroyed by GLOF events such as floods, landslides, etc. This would leave the transmission lines without any product to transmit thereby reducing or eliminating their economic value.
- Risk of increased erosion and landslide potential due to increasing storm intensity affecting access roads, operational structures such as substations, bridges and towers.

Given their location, T3 and T2' are most likely to face these risks. These issues will be studied further for the final ESIA, and could result in modifications of the designs to increase the resiliency of the program structures, potentially affecting cost.

# 5. Environmental and Social Screening of Projects

## 5.1 Project Screening

The MCC Environmental Guidelines state:

"As early as possible in the compact proposal review process, MCC will screen each project as described in these guidelines. As part of its review of compact proposals, MCC funding decisions will be informed by the results of screening and, where needed, an Environmental and Social Impact Assessment or other environmental and social impact analysis. To that end, MCC will not fund a project unless there is provision for appropriate screening and appropriate environmental and social impact analysis."

Further, "The result of this screening process will be an environmental classification following the recommendations contained in the OECD Common Approaches and the practices of the World Bank, classifying in accordance with the potential environmental and social impact, and the extent of the environmental and social review required."[194]

In compliance with these requirements, the proposed projects to be funded under the compact have been subjected to a preliminary screening based on desk studies, limited field observations, and inputs from knowledgeable local experts. The screening results have been captured in checklists which are found in Annex A. Table 86 shows the themes used in the screening.

| Table 86. Issues Explored in the Project Screening |
|---|
| **I. AESTHETICS**<br>Would the project: |
| a) Have a substantial adverse effect on scenic vistas or resources? |
| b) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area? |
| **II. AGRICULTURE & FORESTRY**<br>Would the project: |
| a) Negatively affect agricultural lands (terraced, irrigated, and others)? |
| b) Pass through community forests, National, Leasehold or Production forests, including any formally designated preservation categories? |
| **III. BIODIVERSITY**<br>Would the project affect: |
| a) Modified, natural and critical or sensitive habitats? |
| b) General terrestrial ecology and biodiversity zones, including any possible rare, endangered, threated or endemic species/habitats? |

[194] https://www.mcc.gov/resources/doc/environmental-guidelines ; accessed on November 9, 2016

| Table 86. Issues Explored in the Project Screening |
|---|
| c) Ecosystem services, including provisioning, regulating, cultural or supporting services? |
| d) Formally designated protected categories (Ramsar sites, National Parks, other conservation/preservation categories? |
| **IV. CULTURAL RESOURCES**<br>Would the project affect: |
| a) Cultural resources (archaeological, paleontological, historic, touristic or other)? |
| **V. PHYSICAL RESOURCES**<br>Would the project affect: |
| a) Geo-physical and flooding risk, seismic instability, erosion, soil stability, landslides? |
| b) Air Quality and Noise? |
| c) Water Quality? |
| d) Water Resources? |
| e) Hazardous materials and waste? |
| f) Greenhouse Gas Emissions |
| **VI. GENDER ISSUES**<br>Would the project: |
| a) Have gender dimensions: marginalization; access to justice, education and social services; domestic violence, property rights, and political representation? |
| b) Create conditions that may introduce or exacerbate Trafficking in Persons (TIP)? |
| **VII. HEALTH AND SOCIAL SERVICES**<br>Would the project: |
| a) Restrict access to health care facilities? |
| b) Restrict access to educational facilities, social services, etc.? |
| c) Introduce general health hazards (noise, air, water pollution) for local populations? |
| d) Create conditions that might have an impact on the incidence of HIV/AIDS, for example, through influx of "foreign" labor? |
| **VIII. LAND USE**<br>Would the project: |
| a) Affect land use and land use planning (urban, agriculture, pastoral, production forest, barren land, etc.)? |
| b) Adversely affect subsistence farmers, forest users and other vulnerable groups? |
| **IX. POLITICAL ISSUES**<br>Would the project affect: |
| a) Provide opportunities for participation by civil society organizations and NGOs? |
| b) Affect local government activities? |
| c) Provide opportunities for empowerment of women, and the poor, disadvantaged, and vulnerable? |
| **X. SOCIO-ECONOMIC CONDITIONS**<br>Would the project: |
| a) Create conditions that would have an adverse impact on the poverty profile of local communities? |

| Table 86. Issues Explored in the Project Screening |
|---|
| b) Affect local households/communities?<br>▪ Provide opportunities for employment and service provision<br>▪ Adversely affect socioeconomic structures, such as in dividing settlements, introducing foreign labor |
| c) Physically or economically displace populations, particularly the poor, disadvantaged and vulnerable? |
| d) Adversely affect the socioeconomic and cultural activities of ethnic minorities and Indigenous Peoples? |
| e) Affect cultural mores and activities of communities along the area of influence? |
| f) Have impacts on caste structures in local communities? |
| g) Introduce changes to economic activities of local communities? |
| h) Increase the vulnerability of local populations to earthquakes and other natural disasters? |
| i) Increase direct access of local populations to electricity? |
| j) Create hazardous conditions on roads in transport of goods and materials to project sites? |
| **XI. VULNERABLE GROUPS**<br>Would the project affect: |
| a) Vulnerable communities? |
| b) Poverty and inequality: characteristics; access to education and employment; progress in social mobility? |
| c) Child labor incidence, prevention? |
| d) Changes in population, governance, institutions or practices, traditional territorial rights, land use, and economic activities? |

## 5.2 Environmental Categories

The MCC Environmental Guidelines state that MCC will not fund a project unless there is a provision for appropriate screening and environmental and social impact analysis. The Guidelines also require that as early as possible in the compact proposal review process, each proposed project will be screened to determine its potential environmental and social impact. MCC may not provide assistance for any project that is "likely to cause a significant environmental, health, or safety hazard," as defined in Appendix A of the Guidelines. Any such project will be excluded from MCC funding, and would be classified as a Categorical Prohibition. Initial screening indicates that none of the projects would fall into this category.

The screening will also determine those projects that will need further review due to their potential adverse environmental and social impacts, and projects that are in sensitive sectors or in or near sensitive locations. The result of this screening process will be an environmental classification following the recommendations contained in the OECD *Common Approaches* and the practices of the World Bank, classifying in accordance with the potential environmental and social impact, and the extent of the environmental and social review required.

Based on the screening, a preliminary determination of the environmental category of each project was reached, as shown in Table 87. As indicated all projects except for NR4 are classified as Category A, as will be the whole compact transmission line compact component. NR4 is classified as a category B project.

Table 87. Preliminary MCC Environmental Category for the Projects

| Proposed Project | Preliminary Environmental Category | Remarks |
|---|---|---|
| NR1: 400 kV Transmission Line total 270 km | A | The NR1 project is a major trunk line carrying more voltage (400kV) than has been experienced in Nepal up to now. It will pass through many community forests and may affect regional wildlife corridors (for example as defined in the CHAL program). Some parts of the NR1 transmission line will be built on ridges, thereby affecting scenic views for persons in the vicinity, including tourists and residents. The project will impact farmlands and approximately 618 structures requiring resettlement and livelihoods restoration. NR1 also passes through the ridges of Kulekhani watershed, which is the origin of rivers that feed to Kulekhani hydropower plants –the only reservoir type projects in Nepal. |
| XB1: 400 kV Transmission Line 23 km | A | The XB1 project is a major transmission line carrying more voltage than has been experienced in Nepal up to now. It will pass through many agricultural areas, community forests and may affect regional wildlife corridors (for example as defined in the TAL program). Some parts of the XB1 transmission line will be built on ridges, thereby affecting scenic views for persons in the vicinity, including tourists and residents. The project may trigger Executive Order 12114 if impacts related to the project occur in India. The project will impact farmlands and approximately 26 structures requiring resettlement and livelihoods restoration. |
| T8: 400 kV Transmission Line 47 km | A | The T8 project is a major transmission line carrying more voltage than has been experienced in Nepal up to now. It will pass through many agricultural areas, community forests and may affect regional wildlife corridors (for example as defined in the TAL program). Some parts of the T8 transmission line will be built on ridges, thereby affecting scenic views for persons in the vicinity, including tourists and residents. The project may trigger Executive Order 12114 if impacts related to the project occur in India. The project will impact farmlands and |

Table 87. Preliminary MCC Environmental Category for the Projects

| Proposed Project | Preliminary Environmental Category | Remarks |
|---|---|---|
| | | approximately 58 structures requiring resettlement and livelihoods restoration. |
| T3: 220 kV Transmission Line 30 km | A | The T3 project will pass through many agricultural areas, community forests and may affect regional wildlife corridors (for example as defined in the CHAL program). Some parts of the T3 transmission line will be built on ridges, thereby affecting scenic views for persons in the vicinity, including tourists and residents. A new bridge and 20 km access road will need to be built. The T3 crosses river valleys 4 times, risking birds flying within the valleys. The project will impact farmlands and approximately 189 structures requiring resettlement and livelihoods restoration. |
| T2': 220 kV Transmission Line 23 km | A | The T2' project will pass through many agricultural areas, community forests and may affect regional wildlife corridors between refuge areas. Some parts of the T2' transmission line will be built on ridges, thereby affecting scenic views for persons in the vicinity, including tourists and residents. The T2' crosses river valleys 3 times, risking birds flying within those valleys. The project will impact farmlands and approximately 32 structures requiring resettlement and livelihoods restoration. |
| NR3: 132 kV Transmission Line 110 km | A | The NR3 project will pass through many community forests and may affect regional wildlife corridors (for example accessing the Koshi Tappu Wildlife Reserve). Some parts of the NR3 transmission line as it approaches Ilam will be built on ridges, thereby affecting scenic views of hills and tea gardens for persons in the vicinity, including tourists and residents. The project will impact farmlands and approximately 263 structures requiring resettlement and livelihoods restoration. |
| NR4: 132 kV Transmission Line 131 km | B | The NR4 project consists of adding another circuit to an existing line. There may be impacts to migrating birds and possible social concerns related to the construction of the original line. However, impacts are expected to be less adverse than those of the other project mentioned here. The project's land acquisition process was completed under a previous project. |

## 5.3 Transboundary Impacts

The MCC Environmental Guidelines include procedures that MCC is required to use to implement Executive Order 12114. [195] This Executive Order applies to:

> "b. MCC action that significantly affects the environment of a foreign nation not involved or participating with the United States in the action;"

When this occurs, "MCC will take into consideration an appropriate environmental review in accordance with the criteria in the 'Environmental Review' section of these guidelines."
Further, "MCC will contact the State Department for coordination of all communications with foreign governments concerning environmental agreements and other arrangements."

The projects being considered will facilitate trade in electric power between Nepal and India. As stated in the RFQ[196], "Nepal and India recently commissioned the first major cross-border interconnection point for power exchange between Dhalkebar (in Nepal) and Muzaffarpur (in India) in south-eastern Nepal. This line, once energized to its full potential, will provide an opportunity for Nepal to reduce and potentially eliminate load-shedding through electricity imports for India. Eventually, as Nepal's electricity generation capacity grows, the cross-border line may be used to export electricity to India as well, especially during the wet season in Nepal. However, analyses indicate that for reasons of capacity and reliability Nepal and India will soon require at least one more interconnection point, and several more interconnections (up to six) are planned for the future."

Given this background, it is reasonable to assume that India may experience some environmental or social impacts from needed infrastructure to be developed on the India side to accommodate the program. These impacts might range from those related to new or enhanced transmission lines, substations, or even additional electricity generation. During the development of this PESIA the India Government was not contacted. Further, impacts outside of the Nepal border in India are not addressed in this PESIA.

MCC should investigate whether Executive Order 12114 is applicable to these potential compact projects. If MCC determines that Executive Order 12114 applies, MCC should proceed with an environmental review of transboundary impacts and contact the State Department to coordinate all discussions with India.

[195] 44 Fed. Reg. 1957 (January 9, 1979). Executive Order 12114, January 4, 1979, (the "Executive Order").
[196] MCC 2016. Request for Quotation MCC-16-RFQ-0180, Infrastructure Consulting Services – Energy Nepal

# 6. Environmental and Social Impact and Mitigation Measures

As in Chapter 4, this chapter presents a summary of potential impacts and mitigation measures that are common to all the projects and all regions, followed by individual project-by-project assessments.

## 6.1 General Environmental Impacts and Mitigation Measures

This section addresses the likely adverse and positive impacts of the construction and operation of the seven proposed transmission line projects, in general.

Transmission line projects generally have less significant impacts than other infrastructure activities. While new substations and transmission line towers will have perceptible impacts in the acquisition of lands and attendant involuntary resettlement implications (which are dealt with separately as part of the resettlement planning and implementation process), the general impacts of the lines are not particularly significant. Exceptions can occur in forest areas in which trees will have to be coppiced and ROWs cleared, which may have impacts for access to non-timber forest products and potential loss of incomes.

The social issues customarily associated with infrastructure development are even more prominent in Nepal, where, among others, significant incidence of poverty, occasional natural calamities, high out-migration levels, diverse ethnic minorities, major trafficking hotspots, and a complex caste system all combine to exacerbate vulnerability. High levels of out-migration, characteristic of all the project areas, make women particularly vulnerable. Out-migration provides pathways out of poverty for many and is seen to alter domestic and community patterns over time. Some women take on aspects of non-traditional roles in the absence of husbands and male relatives, and some are scrutinized by families-in-law and communities accustomed to defining wives' value by what they do for their husbands. One study investigated the extent to which rural women benefit from the out-migration of men, finding that larger remittances generally helped to reduce women's physical work burden and to increase decision-making roles, thus empowering the women left behind. However, low remittances had the opposite impact, saddling women with a greater physical workload to shoulder alone.[197]

Gender dimensions in the project-affected areas, and indeed across Nepal, cut across households and communities, and are wide-ranging, from domestic violence to trafficking to lack of empowerment. Together with child labor, those challenges face construction activities, and the contractor clauses will reflect mitigation measures that are described in the ESMP. Construction traffic will also create

[197] A. Maharjan, S. Bauer, B. Knerr. *Do Rural Women Who Stay Behind Benefit from Male Out-migration? A Case Study in the Hills of Nepal.* Gender Technology and Development. Vol. 16 No. 1. 2012.

significant road safety issues, both in transport of heavy machinery to new substations, regular communications, and in use of the access roads that will be needed for line maintenance – many of those access roads will be temporary intrusions into community lands or forests. With local populations traversing forests and agricultural fields, tower safety is also a factor; warning signs and safety measures will be put in place as part of the ESMP.

The PESIA has not identified any Indigenous Peoples groups that would be affected directly by the projects, or who have traditional governance structures to the extent that IFC PS 7 would be triggered. However, such groups do exist in Nepal[198] and verifying this will be an important outcome of the ESIA, as discussed in Chapter 9 and Annex I.

The construction of substations and transmission lines will also have positive impacts in offering employment and service provision opportunities to qualified local populations, which should also be directed to women and disadvantaged communities. Local contracting capabilities can also be strengthened if some services can utilize their skills. It is intended that skills training will be part of the benefit-sharing program and that subsequent employment of trained participants will generate incomes among local populations. One aspect of note is that given the low levels of literacy in many of the districts, appropriate methods of communication will have to be devised so that not only is there meaningful engagement with the communities, but also proper advertisement and encouragement of employment and service provision opportunities in local communities.

The tables on the following pages present an analysis of the total number of workers that will be required to build the transmission lines for each of the projects. The main purpose of the analysis is to determine whether the impacted districts have a sufficient work force to allow the participation of local workers, both skilled and unskilled, and both men and women. The analysis indicates that the total number of construction-related jobs that will be created and maintained over 2.5 to 3 years (the estimated construction period) will be about 5,250, or less than one percent of the employed population of the impacted districts. This suggests that there are sufficient workers (both men and women) available in those districts. Some permanent jobs are likely to be created at the substations and for maintenance purposes. Experience in other compacts indicate that about 40-50 persons would be permanently employed at the substations[199].

Of course, any prediction of 'likelihood' of local employment goes beyond numbers of available/potential persons and has to be couched in an acknowledgement that there are any number of factors that influence this (skills/qualification, cost efficiencies, time and child care availability, people's access to information / knowledge about the opportunities, contractors' decisions…). The employment opportunities will be enhanced if there is a comprehensive training program that accompanies the project, both by the contractors and as a benefit sharing mechanism.

[198] See, for example: http://www.nepaldemocracy.org/institutions/traditional_local-governance.htm ; and, http://www.myrepublica.com/news/11273 Accessed 18 January 2017
[199] See: http://mwnation.com/mcas-phombeya-substation-construction-on-track/ Accessed 18 January, 2017

Table 88. Assumptions for Workforce Requirements per Transmission Tower

| | | Skilled: | 30% | Unskilled: | 70% |
|---|---|---|---|---|---|
| For 220 kV | total | male | female | male | female |
| | | 90% | 10% | 50% | 50% |
| Foundation | 30 | 8 | 1 | 11 | 11 |
| Erection | 20 | 5 | 1 | 7 | 7 |
| Stringing | 50 | 14 | 2 | 18 | 18 |
| **total:** | **100** | **27.0** | **3.0** | **35.0** | **35.0** |
| Time required per tower | 20 | calendar days | | 2,000 | workdays |

| | | Skilled: | 30% | Unskilled: | 70% |
|---|---|---|---|---|---|
| For 400 kV | total | male | female | male | female |
| | | 90% | 10% | 50% | 50% |
| Foundation | 45 | 12 | 1 | 16 | 16 |
| Erection | 30 | 8 | 1 | 11 | 11 |
| Stringing | 75 | 20 | 2 | 26 | 26 |
| **total:** | **150** | **40.5** | **4.5** | **52.5** | **52.5** |
| Time required | 20 | calendar days | | 3,000 | workdays |

| **Total workers per tower** | 220KV | 400KV |
|---|---|---|
| | **50** | **75** |

Source: personal communication, M/S Sigma Con. P. Ltd.; Electrical Engineering Services; Baneshwor, Kathmandu, Nepal

| | | Workers per tower | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Skilled: | | Unskilled: | | | 50% (for Stringing only) | | | | | Skilled: | | Unskilled: | |
| Tx Line | Number of Towers | male | female | male | female | crew size | Calendar Days Required | number of crews | Total const. time (days) | Total const. time (years) | Total number of workers | male | female | male | female |
| NR1 | 1,008 | 40.5 | 4.5 | 52.5 | 52.5 | 150 | 20,160 | 20 | 1,008 | 2.8 | 3,000 | 810 | 90 | 1,050 | 1,050 |
| XB1 | 52 | 40.5 | 4.5 | 52.5 | 52.5 | 150 | 1,040 | 1 | 1,040 | 2.8 | 150 | 41 | 5 | 53 | 53 |
| NR3 | 439 | 27 | 3 | 35 | 35 | 100 | 8,780 | 9 | 976 | 2.7 | 900 | 243 | 27 | 315 | 315 |
| NR4* | 520 | 14 | 2 | 18 | 18 | 50 | 5,200 | 6 | 867 | 2.4 | 300 | 81 | 9 | 105 | 105 |
| T8 | 89 | 40.5 | 4.5 | 52.5 | 52.5 | 150 | 1,780 | 2 | 890 | 2.4 | 300 | 81 | 9 | 105 | 105 |
| T3 | 149 | 27 | 3 | 35 | 35 | 100 | 2,980 | 3 | 993 | 2.7 | 300 | 81 | 9 | 105 | 105 |
| T2prime | 117 | 27 | 3 | 35 | 35 | 100 | 2,340 | 3 | 780 | 2.1 | 300 | 81 | 9 | 105 | 105 |
| **Totals** | **2,374** | | | | | | | **44** | | | **5,250** | **1,418** | **158** | **1,838** | **1,838** |
| Note: * NR4 numbers for stringing only. | | | | | | | | 119 = average crew size | | | | 27% | 3% | 35% | 35% |

| | Non-agricultural* Employed | | Non-agricultural* Unemployed | | Total Tx Jobs | | **Tx Jobs as % of total non-agriultural employment** | | **Tx Jobs as % of total non-agriultural unemployment** | |
|---|---|---|---|---|---|---|---|---|---|---|
| Tx Line | Male | Female | Male | Female | Male | Female | **Male** | **Female** | **Male** | **Female** |
| NR1 | 432,442 | 248,827 | 26,985 | 24,999 | 1,860 | 1,140 | **0.43%** | **0.46%** | **6.9%** | **4.6%** |
| XB1 | 13,453 | 17,150 | 133 | 47 | 93 | 57 | **0.69%** | **0.33%** | **70.2%** | **120.4%** |
| NR3 | 287,147 | 188,280 | 5,946 | 2,728 | 558 | 342 | **0.19%** | **0.18%** | **9.4%** | **12.5%** |
| NR4* | 145,080 | 278,211 | 3,863 | 1,623 | 186 | 114 | **0.13%** | **0.04%** | **4.8%** | **7.0%** |
| T8 | 75,541 | 55,171 | 1,282 | 576 | 186 | 114 | **0.25%** | **0.21%** | **14.5%** | **19.8%** |
| T3 | 23,800 | 63,187 | 1,471 | 325 | 186 | 114 | **0.78%** | **0.18%** | **12.6%** | **35.1%** |
| T2prime | 45,684 | 51,784 | 411 | 130 | 186 | 114 | **0.41%** | **0.22%** | **45.2%** | **87.5%** |
| totals | 1,023,146 | 902,610 | 40,092 | 30,430 | 3,255 | 1,995 | **0.32%** | **0.22%** | **8.1%** | **6.6%** |

* "Non-agricultural" includes:
Wage/ Salary Earning, Own Non-Agricultural, Extended Economic, and Seeking Job categories

**Figure 46. Calculation of Numbers and Types of Workers for Construction of the Transmission Lines**

The environmental and social impact of a transmission line construction project could be assessed in several different ways. Commonly used measurements of impacts may comprise area, distance (length), or the number of transmission structures. The impact of new transmission lines including substations, and transmission towers and lines, would depend on the existing land uses and topography of the area. In forested areas, the entire right-of-way (ROW) width would have to be cleared and maintained free of tall-growing trees for the entire life of the transmission line. The result is a permanent change to the ROW land cover as well as social impacts on the forest user community when the community holds usufructuary rights for sustainable resource use, as in the case of community forestry practiced in Nepal. During construction, heavy construction vehicles traversing the ROW and temporary or permanent access roads could limit or suspend the use of the land for crop production, in agricultural areas. Land would have to be permanently acquired for substations and access roads for maintenance while the land beneath the line could be allowed to be cropped or pastured with monitoring, after construction. Thus, the area permanently affected by the line is usually much smaller than the area temporarily affected during construction. Further, where transmission lines are routed through areas that are valued for their scenic qualities, as in many scenic mountain and trekking areas of Nepal, the visual impacts of the line could extend well beyond the ROW.

The quality of the existing environment is influenced by several factors as, the level or degree of disturbance that already exists, uniqueness of the resources of the area the proposed transmission routes traverses, and the threat of future disturbance. Therefore, the degree of impact of the proposed transmission line projects has been determined by considering the quality or uniqueness of the existing environment along the ROW of the identified route. Due consideration has been given to both long-term and temporary impacts of the construction of the transmission line projects. Long-term impacts that would exist as long as the line is in place such as land use restrictions, loss of forested including restrictions on wild life corridors, impact on bird flyways and aesthetic impacts, and temporary impacts that would occur during construction or at infrequent intervals such as during line repair or ROW maintenance such as noise or crop damage and adverse impact on wild life, were considered in detail. Short-term impacts can become long-term impacts if not properly managed or mitigated.
An important mitigation measure that applies to all environmental and social impacts is the establishment and implementation of a Stakeholder Engagement Plan to be in force for the life of the projects. Annex C presents a framework that has been developed by MCC and OMCN to guide this process.

### 6.1.1 Impact Assessment Methodology

Field inspection of all alignments for the preliminary ESIA was not possible. This was primarily caused by the length of line, in excess of 600 km, most of it through inaccessible terrain, the compact time frame of 4-5 months within which this PESIA would be developed, and the fact that alignment routings and substation designs and specifications were being developed simultaneously with the environmental and social research and analysis.

To compensate for these challenges, a multi-level impact evaluation process was utilized in conjunction with transmission line and substation routing and location decisions described earlier,

more than two dozen selected site visits, and a multidisciplinary visual inspection of detailed aerial / satellite photographs. This approach serves as starting point for the more detailed analysis to be conducted during the preparation of the final ESIA.

This latter inspection procedure was accomplished using a unique approach utilizing the combined expertise of teams comprised of senior design personnel, including in most instances input from the chief electrical transmission and substation engineer, environmental and social (ES) specialists, and resettlement specialists. Kilometer-by-kilometer large-scale imagery of each line segment and substation location was projected at high resolution on a screen, and the team jointly evaluated the potential technical, environmental, social, and resettlement impacts of alternative alignments. This exercise, with real-time combinations of qualified technical experts has possibly not been implemented heretofore to the depth and detail as was done for the MCC Nepal transmission line project. It is largely for this reason that elimination of most adverse environmental impacts was made possible, fulfilling in large measure the current advances advocated for ESIA analyses: to "mainstream" ES factors into the project planning and design process, rather than evaluating ES impacts "after the fact" of design completion. Figure 47.  illustrates the procedure used.

This process resulted in hundreds of individual adjustments and decisions that were incorporated into the 21-multidisciplinary routing, inspection and siting exercises that were conducted over the course of four weeks when the entire team was present in Kathmandu. The results of these exercises are summarized for each project in this chapter.

These subsections may be considered jointly with the description of the projects and their existing environmental conditions in Chapter 4, with the general ES impacts and mitigations described in detail in Chapter 6, and in conjunction with the ESMP (bound separately) The specific clauses applicable to each project are referenced in the summaries below. The subsection summaries are intended to be "stand-alone" documents, separable in case not all projects are included in the final compact proposal. They also serve as starting points for more detailed analysis during the final ESIA.

The following sections  provide more details on the types of impacts that have been considered in this PESIA.

Multidisciplinary routing and impact evaluation team. Design engineers, resettlement specialists, environmental and social experts participated. Starting point was usually with the LRT alignment.

Engineer "fine tunes" location of substation and substation footprint (New Hetauda SS) in order to avoid settlement area. Also discussed was routing of small irrigation canal transecting corner of site.


Many routings and river crossing alternatives were examined.

**Figure 47. Illustration of Multi-Disciplinary Routing "Fine-tuning" Adjustment Exercise**

In considering the impacts for their significance and formulating mitigation the impacts were categorized as High, Medium and Low. The categorization of the impacts of the project was carried out with due consideration to magnitude, extent and duration of the impacts as presented in the classification matrix presented as Table 89.

Table 89. Matrix for Classifying Impacts

| Type | Criteria | Impact |
|---|---|---|
| Magnitude | Hard to Mitigate or high effect | High |
| | Mitigated with some precaution or medium effect | Medium |

| | | |
|---|---|---|
| | Easily mitigated or low effect | Low |
| Extent | Within Development Region | Regional |
| | Within Project Ward/VDC | Local |
| | Within the Project Site | Site Specific |
| Duration | > 5 years | Long Term |
| | 1 to 5 years | Medium Term |
| | < 1 years | Short Term |

### 6.1.2 Adverse Impacts

Impacts of a power transmission project with respect to environmental compatibility and community acceptance should be considered throughout the life cycle of the project commencing from planning stage through operation. For more details on mitigation measures, please see “Assumptions for Costing of Mitigation Measures” in Annex K.

Planning: Successful design, construction and operation of a power transmission development project begins with proper planning where site selection is of foremost importance as this could significantly impact the ability to achieve community acceptance and environmental compatibility. Deciding on the location of the site and where to place equipment on that site, inspections of the proposed site for potential environmental impacts, and measurement of ambient noise and electromagnetic field (EMF)

Design: The design of the project is the next step where proper line routing with emphasis on avoiding/ minimizing potential impacts on environment and community both has to be considered in detail. In this respect the routing of the seven transmission lines and locating the substation were carried out through multi-criteria analysis employing Linear Routing Tool (LRT) modelling and long sessions to review and fine tune the alignments generated by the LRT model. While the LRT enabled avoiding/limiting much of the environmental impacts as impact on national parks, forest and wild life including protected species and agriculture areas, the fine-tuning exercise facilitated avoiding impacts on built up areas, landslide prone areas and bird flyways. However, in avoiding the many environmental and social impacts trade-offs had to be made considering 1) the assigned weights for social and environmental attributes in the LRT, 2) technical feasibility with due regard to topography, drainage and stability of land, and 3) availability and usability of available land. The resultant routing and substations locations would impact some forests, agriculture areas, a few bird flyways, and built up areas.

Construction: During construction site preparation and construction activities could result in a multitude of environmental impacts and greatly influence community acceptance. Available controls methods discussed herein and strict adherence to the ESMP would avoid/minimize most of the significant adverse impacts.

Operation and maintenance: Adverse impacts during operations and maintenance of the transmission lines could be avoided/minimized by good site housekeeping, providing adequate physical site security and fire protection, and management of hazardous material[200]

**Forests**

*Impact*: Considering the land area under forest cover in Nepal the lines traversing some forest areas is inevitable. The forest areas falling within the ROW-46 m wide corridor for 400kV lines, 30 m wide corridor for 220 kV lines, and 18 m wide corridor for 132 kV lines- will have to be cleared of trees which are taller than 3 m. This removal of trees would have to be carried out all along the ROW of the line and this would generate many adverse impacts:

- Contributing to release of sequestered carbon
- Segregation of wildlife habitats and obstructing corridors
- Loss of community and leasehold forest areas with attendant loss of income.

When the total forest area affected by 611 km of 400 kV lines, 53 km of 220 kV lines and 241 km of 132 kV lines and 27 km of paved single lane access roads are taken into consideration, the magnitude of the impact is estimated to be in the medium category, and extent of impact estimated as regional and duration of impact long term, using the following classification matrix:

*Mitigation*: The ROW area cleared of trees could be revegetated with plants that do not exceed 3 m in height without any impact on the transmission lines above. Careful selection of plants that do not exceed height limitation and suitable for each impacted area would have to carried out with the assistance of the forest department and when community and leasehold forest areas are affected with the participation of respective affected groups. Plants or shrubs that could facilitate sustainable harvesting of non-timber forest products but do not attract birds would be ideal for revegetation. However, this revegetation would have to be monitored and managed carefully. A tripartite agreement where the transmission line owners, Department of Forests and community/Leasehold user groups would be required to be signed when the revegetation is to be carried out in community/leasehold forest areas and funding for initial revegetation and maintenance would have to be provided through project funds. When forests under the Department of Forests are affected revegetation can be handed over community based organizations under a tripartite agreement as above, but the area allocated for revegetation should have to be such that it would be feasible to generate adequate income for maintenance and a small profit. When the affected area is in a wildlife corridor the revegetation should be the responsibility of the Department of Forests as community incursions to wildlife habitats would also render the habitat unsuitable for wildlife. Initial funding for both these instances should be from the project funds and for the vegetation maintained by the Department of Forests it is proposed that the transmission company would provide the maintenance cost from its annual budget. ESIA will provide details of this mitigation which has been agreed to by WWF, Nepal, in initial meetings. It is recommended that ESIA process include further consultations with WWF on this mitigation action and on other measures proposed elsewhere with regard to protection of birds.

[200] IEEE Standards Association. 2013. Guide for the Design, Construction and Operation of Electric Power Substations for Community Acceptance and Environmental Compatibility. IEEE Std 1127™-

**Birds**

*Impact:* As revealed through discussions with WWF, Nepal, birds, especially high flying birds of prey such as eagles, raptors, and large vultures use river valleys as flyways. Powerlines across river valleys can cause bird deaths by electrocution and collision. Birds sitting on power poles or power lines are killed if they cause short circuits between energized lines or short-to- ground. The large wingspan of some of these birds appears to be the single most important factor in their susceptibility to electrocution. In addition to their size, the perching behavior of these bird species puts them at greater risk. Species that prefer exposed high perches are more likely to be attracted to power poles, as are the species that use a "still hunting" technique in which they perch and visually search the landscape for prey rather than hunting in flight. In flight, birds can collide into power lines as power cables are often difficult to see, especially in fog-prone areas such as the NR1 corridor between Naubise and New Damauli. In most cases the impact of collision leads to immediate death or fatal injuries and mutilations. The problem of collision particularly affects large, heavy birds with poor maneuverability. These impacts on birds could be very significant during migration of birds from Sub-Saharan Africa, South-east Asia, North-east India, and South India. Whereas resident birds can adapt to obstacles in their habitat birds on migration and stop overs can hardly adapt as they remain in the area only for a short time. Using the criteria shown in Table 89, the magnitude of impact can be considered medium to high without mitigation, regional in extent, and long term in duration.

*Mitigation:* Most commonly used mitigation measures are attaching conspicuous Orange Fiberglass balls and solar powered Reflectors to warn the birds of the obstruction by power lines, fixing auditory signal generating devices as wind chimes and maintaining canopy height above the lines outside of the ROW to induce birds to above the power lines. Bird electrocutions in general, and raptor electrocutions can be reduced by adopting safe electrical pole and line configurations or managing perching. Provision of platforms for safe perches and nesting locations on power poles during the design of power poles will further mitigate impact on birds.

Other measures which should be investigated and adopted during the detail design stage are specific technical solutions at the cord's design, such as the marking of lines, and removal / burial of the top (neutral) line[201]. Another measure to be investigated for adoption during detailed design is that power pylons with suspended insulators should be considered instead of pylons with an exposed loop of wire above the insulator.[202] The ESIA process should include discussions with WWF, Nepal, and Bird Conservation Nepal to formulate mitigation measures, elaborating those mentioned herein, to avoid/reduce bird deaths from transmission lines.

**Visual Aesthetic Value**

*Impact:* Transmission lines and towers along the valleys and on Middle Hills and Tarai area would reduce the aesthetic appreciation of the area where scenic beauty is an endowment of nature. This would be more significant in areas where tourists go for the scenic beauty. Using the matrix in Table

[201] Electrocution and collision of Birds with Powerlines. COP 10 Convention on Birds. https://www.regjeringen.no/contentassets/5480e0243522455687338a6c33ebd9f4/electrocution_of_birds_and_collision_with_power_lines_sorensen_111124.pdf. Accessed 21 Nov 2016

[202] Ferrer, M, De La Riva, M, and Castrovi, 1984. Electrocution of raptors on power lines in southwestern Spain. j. Field Ornithol., 62(2):181-190

89, the overall magnitude of impact is considered to be low, its extent local and its duration long term.

*Mitigation:* Wherever possible, the design would endeavor to run the lines below the edge of the mountains to avoid the lines protruding out of the landscape and enable merging with it.

**Wetlands and Aquatic Habitats**
*Impact:* Wetlands aquatic habitats traversed by or in the vicinity of the Transmission lines will be subjected to degradation form construction or construction related activities. The impact would be of low magnitude, local in extent, and of short duration.

*Mitigation*: Mitigation would include avoid disturbing wetlands and aquatic habitats by routing the transmission lines away or around wetlands and siting access roads, towers, and substations to avoid wetlands and aquatic habitats would avoid degradation of these ecosystems critical habitats enclosed therein.

Recommendations for avoiding contamination of wetlands and protection of aquatic habitats include:

- Use of silt screens and other appropriate measures to avoid contamination of wetlands and aquatic habitats
- Maintaining fish access when road crossings (access roads) of watercourses are unavoidable by utilizing clear span bridges, open-bottom culverts
- Minimizing clearing and disruption to riparian vegetation
- Restoration of wetlands, or replacement in kind if restoration not possible, after construction.[203]

These mitigation measures would be specified in a Wetlands Mitigation Plan, and further elaborated in the ESMP of the full ESIA.

**Hydrological Impacts**
*Impact:* Potential hydrological impacts of the proposed projects are obstructions to surface run off and flood damage to project facilities as substations and downstream locations. The magnitude of the impact could be considered low, its extent regional, and its duration short term.

*Mitigation:* Measures to mitigate adverse hydrological impacts are designs to facilitate efficient and uninterrupted peak surface runoff and design of cost-effective drains to collect and appropriately treat runoff water prior to discharge to local water courses to prevent waste streams from project facilities. Develop Non-Point Source/Storm water Management Plan for Each Project. To control transport of sediments off the site and to protect downstream properties and waterways during construction, a combination of standard best management practices (BMPs) can be used including fenced clearing limits, stabilized site roads, equipment parking areas, temporary ground cover in

[203] IFC. 2007. Environmental, Health, and Safety Guidelines, Electric Power Transmission and Distribution, International Finance Corporation, April 2007.

disturbed areas, stabilized conveyance ditches, a large sediment pond, and silt fencing. Substations will require contouring and channels to sediment pond.

**Electric and Magnetic Fields (EMF)**
*Impact:* High voltage power lines may cause adverse impacts to nearby populations from EMF. The impact's magnitude is low, its extent local and its duration long term.

*Mitigation*: Though not established yet that EMF from powerlines could generate adverse health impacts adopting the precautionary principle the following mitigation measures[204] are proposed:

- Assessing the potential exposure to the public against the reference levels developed by the International Commission on Non-Ionizing Radiation Protection
- Siting the power transmission facilities to avoid or minimize exposure to the public. Avoiding installation of transmission lines or other high voltage equipment above or adjacent to residential properties or other locations intended for highly frequent human occupancy, (e.g. schools or offices), should be avoided
- If EMF levels are confirmed or expected to be above the recommended exposure limits, application of engineering techniques should be considered to reduce the EMF produced by power lines, substations, or transformers. Examples of these techniques include:
  - Shielding with specific metal alloys
  - Burying transmission lines
  - Increasing height of transmission towers
  - Modifications to size, spacing, and configuration of conductors.

**Landslides**
*Impact:* landslides could be a problem in landslide prone areas and may be triggered by use of heavy machinery and excavations and cutting into slopes. Landslide mitigation also considers earthquake and flood induced landslides. Impact magnitude is low, its extent local and its duration long term.

*Mitigation:* Designing towers and substations using landslide prevention design standards and locating the facilities in stable areas, as far as possible would avoid landslides. In addition, using best practices in construction to prevent vibration from heavy machinery, excavation, grading and slope cutting to trigger landslides.

**Safety**
*Impact:* If the transmission line facilities are not designed using safety measures it would be difficult to prevent injury and fatal events to public. Impact magnitude is medium, its extent local and its duration short term.

*Mitigation*: Mitigation measures include, designing the transmission line facilities using latest safety measures such as fences, signs, controlled entrances and other safe guards, awareness building training for public, including children, on the dangers of transmission lines, towers, and substations, and provide reflectors or other methods as appropriate to increase the visibility of these facilities

[204] IFC. 2007. Environmental, Health, and Safety Guidelines, Electric Power Transmission and Distribution, International Finance Corporation, April 2007.

**Land Acquisition**

*Impact:* Although the exact number of structures that would be impacted by the substations and the number of tower pads to be located in forested and cultivated area are not known at this preliminary environmental and social impact assessment stage, it is expected that some adverse impact on land with structures, and forest and agriculture land would be unavoidable, notwithstanding the LRT modelling and fine tuning the routes. In addition, the access roads, though limited in extent, would also require acquisition of land that may be forested or under cultivation. The impact of acquisition land with structures particularly residences would be very significant as the affected persons would face physical and potential economic displacement. Further, restrictions imposed by the power lines on the land use in the ROW would impose limitations on land use of the area, particularly on sustainable use of forest resources.

*Mitigation:* The resettlement impacts of each of the seven projects have been studied and ways to mitigate the impact have been addressed in the Resettlement Framework (RF) presented as a separate but integral part of this Detailed Feasibility Studies (DFS) report.

## CONSTRUCTION PHASE

**Borrow Pits, Quarries and Waste Disposal Sites**

Impact: Extraction of material from borrow pits and quarries could cause erosion and dust generation in addition to enhanced noise levels. The topography of the area could be altered and the sites may become aesthetically undesirable. While exhaust from construction machinery and haulage vehicles and dust could cause air quality deterioration from gases as NOx, CO, and SOx and particulate matter ($PM_{10,}$ $PM_{2.5,}$) disposal of construction waste and waste from contractor's camps could contaminate water bodies in the vicinity. These impacts would be very low in magnitude, local in extent and short term in duration. Further, except in a few built-up areas there would be no sensitive receptors.

However, if paved roads and bridges are to be built to transport material and machinery, the impact would be significant as the magnitude would be high, extent regional and duration short to long term. Further, extraction of material for road embankments and other resources as water and energy would also cause environmental stress. If these roads are used for maintenance these could lead to increased levels of poaching and transportation of unauthorized forest products including timber.

*Mitigation:* Dust and noise control measures, which will be elaborated in the ESIA following IFC guidelines,[205] should be adopted and permits for operation of borrow pits and quarries and disposal of waste in approved areas should be obtained from respective local authorities. Further, use of existing utility and transport corridors for transmission and distribution, and existing roads and tracks for access roads, whenever possible should be adopted to minimize the impact of road construction.

[205] IFC. 2007. Environmental, Health, and Safety Guidelines, Electric Power Transmission and Distribution, International Finance Corporation, April 2007

If the roads are to be used during operation phase for maintenance, suitable monitoring mechanisms to police poaching and unauthorized use of forest product would have to be put in place. These measures will be recommended in the ESIA.

**Soil Erosion**
*Impact:* Project construction activities including excavation for borrow material and quarrying and spoil would result in some degree of soil erosion.

*Mitigation:* Mitigation would include, utilize already used areas for earth borrowing, quarries, and disposal sites, wherever possible and implementing erosion protection measures as gabions, gravel/or vegetation cover, particularly on steep slopes and along river banks, according to best practice standards.

**Accessibility**
*Impact:* During construction roads in the vicinity of the projects would be constantly used for haulage of construction equipment, machinery and materials causing access problems to the local community.

*Mitigation*: Mitigation measures would include providing access to all properties during the construction period and ensuring access for disabled persons in the designs of cross-walks and other required features.

**Historic/Cultural Monuments and Features and Intangible Cultural Resources**
*Impact:* Nepal is a country where civilization existed as far back as c. 1500 BCE, and, therefore, encountering such monuments in construction related excavations is a distinct possibility. Although the line routing has avoided impacts on cultural monuments and features as far as possible, it is important that any chance findings during excavations for project activities be protected. The magnitude of the impact is high although local in extent and short term in duration. Further, practices of communities embodying traditional lifestyles may be disrupted. However, the magnitude of this impact is low, local in extent and short term in duration.

*Mitigation:* Mitigation measures to protect the monuments from damage by construction activities are ceasing work as soon as historical/cultural monuments are encountered during construction activities and informing the relevant authorities including the Ministry of Culture. The Contractor will inform the Engineer of the situation who may propose a new location or other mitigation. The ministry would implement measures to avoid damage to monuments and valuable features which the contractor is bound to follow. Awareness programs for contractor staff would ensure minimum disturbance to traditional practices of the communities.

**Loss of Standing Crops**
*Impact:* In the cultivated land through which the transmission line passes the potential loss of standing crops in the land falling within the ROW, during construction, is another significant impact as this would affect the livelihood of the cultivators. The magnitude of the impact would be high and the extent, though limited in width, would extend all the way through the project areas running the length of the power line while the duration is short term as the impact would be limited to the length of construction activities.

Moreover, the adjoining land areas at the verges of ROW and tower pads may be affected due to movement of construction machinery and labor force. Potentially the winter crop will be affected as construction may be curtailed or even closed down completely during the monsoon. Although the magnitude of the impact would be low with mitigation recommended in the ESMP and the extent is local, the duration is medium to long term depending on the length of construction activities.

*Mitigation:* Mitigation would be in the form of compensation for loss of income and measures to minimize the loss of standing crops. Compensation for loss standing crop shall be paid based on the present value and loss of fruit trees will also be compensated. While the final mechanism of assessing the adequate compensation and mode of compensation will be incorporated in the Resettlement Action Plan would include mitigation measures to rehabilitate the affected land area to its former state that would enable the owners/tenants to cultivate the land. Construction work will be scheduled to best avoid the cropping season and affected persons will be informed in advance so the loss would be minimized.

**Occupational Health and Safety**
*Impact:* Construction related accidents are common in Nepal, primarily because of unsafe construction practices. The erection of towers and stringing of lines in steep slopes are difficult and strenuous work and smallest error in judgement/negligence of safety guidelines may cause accident and grievous harm. Work related injury and vehicle accidents are the likely impacts. The magnitude of the impact is high if not avoided/mitigated while the extent is localized to the construction sites the duration being long term with potential for accidents and injury extending all through the construction period.

*Mitigation:* Strict observance of MCC/IFC Occupational Health and Safety (OHS) guidelines elaborated in the ESMP with attendant continuous supervision and monitoring of adherence to OHS guidelines would minimize accidents and injury.

**Traffic Management and Construction Safety**
*Impact:* During construction, road use for construction activities as haulage of construction materials, spoil, and equipment, would result in disturbances to vehicular traffic and pedestrians and may cause injury through road accidents. The impact would be of low magnitude, local in extent and short term in duration. However, paved road construction for access would exacerbate the adverse impacts.

*Mitigation:* Mitigation measures would include formulating and implementing a construction-related traffic management plan. The plan should include:

- Installing traffic warning signs, and strict enforcement of traffic regulations during transportation of materials, equipment, and machinery
- Conducting awareness programs for contractor's staff on safety and proper traffic behavior in densely populated areas near the construction sites
- Assigning traffic control personnel/flaggers

- Providing alternative access to pedestrians
- Arranging necessary measures for passer-by safety and all means of transportation safety
- Selecting quarry and borrow sites that are served by roads of adequate capacity for heavy trucks
- Controlling the loading and operating speeds of haulage vehicles
- Repairing damages to roads caused by haulage of construction materials, spoil and equipment, and machinery
- Obtaining approval from local authorities whenever local road are used for transportation;

**Competition for Resources and Conflicts**
*Impact:* During construction, a labor force assembled from different places with different religion and faiths will be employed by the contractor. Therefore, conflicts are likely to arise as a result of competition for use of resources such as food, water, rivers and other bodies in the vicinity for washing and recreation, and places of worship. Where behavioral and cultural practices of the work force are in conflict with traditional and cultural practices of the villagers, especially in areas where the culture and language are different, may lead to conflict. Although the magnitude of impact is considered to be low, the extent local and duration short to medium term, this could become significant if labor from foreign countries is employed.

Sudden cash flow in project area and cash earning of workers creates opportunities for use of alcohol and drugs, gambling and other vices to develop. In addition, the new opportunities arising from project construction will attract new in-migrants to the project area with potential negative impacts on social and cultural aspects, including potential conflicts between the local and the in-migrants populations and exposure of the locals to vices and attendant health impacts. This could cause health problems and spread of STDs including HIV. This impact could be significant in low population areas especially in the hills. Overall, the magnitude of impact is low, extent local and duration medium to long term.

*Mitigation*: The indication of food and drinking water deficit in areas where construction camps are to be established would require that the contractor would have to manage food and water requirement independent of the local resources.

Keeping in view the local customs, traditions and considerations, a set of “rules” will have to be identified in the ESIA, through stakeholder consultation, for the workers – both local and outside and in-migrants. These codes of conduct, would include awareness programs, be included in the Contractor’s General Contract and be enforced to help facilitate a “positive” environment in the project area and thus build a “community” of mutual trust and respect during project construction.

**Gender and Child Labor**
*Impact:* During project construction, daily wage labor will be deployed for excavation and transportation of construction materials and other construction-related works, especially in at high altitudes where difficult terrain precludes the use of machinery. The contractors/sub-contractors may discriminate against women with unequal pay and/or conditions. In general, the physical nature of the work and gender dynamics will likely mean that employment opportunities will be more readily available to men rather than women, although it must be borne in mind that many women in Nepal are already engaged in arduous physical work, would benefit from access to paid work and, in

many project-affected areas, outnumber men. There is a risk that children may be employed by the contractor/subcontractor at low wages. The overall magnitude of these impacts, however, would be low, extent local and duration medium term, considering the nature of construction work and manpower deployed from the localities.

*Mitigation:* The ESMP for the projects will include measures to prevent discrimination against women employed by contractor/sub-contractor and to prohibit child labor. The ESMP will also specify that due priority should be given to project affected persons, vulnerable groups and poor people. Working conditions are addressed in a variety of construction contract documents including (but not limited to) ESMP, Health and Safety Plans and Waste Management Plans. All documents represent construction site requirements that reflect MCC, Nepal and international best practices for establishing a safe and healthy working environment for men and women. Typical "favorable conditions" addressing women include, among others, gender-separated rest and sanitation facilities. This has been referenced in the suggested contractor clauses. Child labor is prohibited.

**Health and Sanitation**

*Impact:* Most of the projects are located in areas where health and sanitation facilities are relatively poor. Health care facilities are not readily available. The likely increase in population of the area during construction may add further stress on local health facilities. Further, the lack of proper health and sanitary facilities in temporary construction camps could affects the health of the workers. The most vulnerable will be women and children in the localities. The magnitude of likely impact is considered to be low, the extent of the impact local and the duration medium term.

*Mitigation:* The temporary camp provided for the project workers should have health and sanitary facilities. Drinking water sources shall be tested prior to mobilization. The contractor shall maintain at least first aid kits and vaccines against infectious and communicable diseases, which will decrease pressure on local health and sanitation facilities. Health check-up of workers will be a requirement.

**Community Expectations**

*Impact:* While the proposed projects are not designed for rural electrification, stakeholder consultations revealed rural electrification was a major expectation. In general other benefits the community would expect are local employment, local infrastructure development as road and health facility improvement and opportunities for supplementary income generation activities. Although not within the scope of the proposed projects, complete disregard of these expectations may create risks to the project especially considering the consent of affected communities on land take for substations and tower pads and land use restrictions in community forests and private land beneath the transmission lines.

*Mitigation:* A benefit sharing program to accommodate community expectations, as much as possible, will be built into the social impact mitigation of the ESIA. There is a body of literature on benefit-sharing in development projects. The benefit-sharing opportunities identified in this report are drawn from a variety of existing development activities in Nepal. A recent study of ongoing benefit sharing concepts in the Nepal hydropower sector can be found at http://www.icimod.org/?q=22643. However, some of these examples are more applicable to energy generation rather than transmission; hence the concepts presented in the PESIA do not include common equity or royalty mechanisms and instead focus on livelihoods and training programs.

## OPERATION PHASE

**Land Use Restrictions and Reduction of Land Value**
*Impact:* Private land transactions though not very common in hill districts, in other relatively flat regions buying and selling of land is common. Electricity regulations prohibit structures/houses along ROW of power transmission lines and trees inside the ROW have to be removed. Due to these restrictions land value, may decrease.

The placement of towers in cultivated areas, especially in the middle of land parcels, could be a hindrance while ploughing using machinery and the farmers may have to use labor intensive cultivation which would increase cost of production. Although the overall magnitude of the impacts is considered to be low, and extent local, the duration is long term.

*Mitigation:* Adequate compensation for the area where land use is restricted and land acquired for tower pads would be included in the Resettlement Action Plan to be prepared during the detailed design stage. Further, practicing agriculture and cultivation of shrubs with economic value should be facilitated in the ROW where land use is restricted.

### Positive Impacts

**Local Employment**
One of the major positive impacts of the project during the construction stage is the creation of employment opportunities. To some extent such employment opportunities may lessen out migration. Employment opportunities would also contribute to poverty alleviation, albeit in the short term.

**Local Economy**
As employment opportunities, income from retail shops, house rental, demand for fresh vegetable and meat, would increase significant amounts of cash will be channeled into the local economy. This short term economic boom will contribute to diversify and development of the local economy and enhancement of the economic status of the local people.

**Increase in Skill Level**
Women and men employed in tower pad assembling, erection of towers, stringing of lines, transportation and operation of equipment will gain additional skills that would be marketable elsewhere, too. The work enhances traditional skills and some marketable new skills will emerge in the area. With these additional skills, local women and men will be better placed to get employment in subsequent development projects.

**National Economy**
The transmission line project will evacuate the energy produced by the hydropower plants throughout the country and provide reliable power supply to load centers all over the country. In addition, the project would also reduce transmission losses and generate revenue by exporting power to India.

**Employment Opportunities**
Regular maintenance of vegetation in the ROW beneath the power lines and other maintenance work is vital for the smooth operation of power line. This will also provide long term employment opportunities

### 6.1.3 Climate Change Impacts

As introduced in Section 4.10, the clearing of ROW under the transmission lines in forested areas would have the effect of precluding the annual capture of up to 13t $CO_2$e/ha. A preliminary estimate[206] of the total area to be cleared from community forests, not counting national or other forest areas, indicates that about 1,240 ha of forest land will need to be cleared in the ROWs of the transmission lines if all the projects are built as currently envisioned. Mitigation will consist primarily of replanting trees and shrubs at a rate that will regain the $CO_2$ capture potential of the cleared trees.

Table 90. Reduction in Annual $CO_2$e Capture as a Result of the Projects

| Project | Total number of CFUGs potentially traversed by the project | Total Area of CFUGs in Districts potentially traversed by the Project (ha) | Estimated CFUG area potentially impacted (ha) | Percent of total CFUG area affected (%) | Loss of annual $CO_2$e capture (t) |
|---|---|---|---|---|---|
| NR1 | 193 | 12,641 | 683 | 5.4% | 8,873 |
| XB1 | 3 | 38 | 5 | 14.4% | 71 |
| T8 | 12 | 3,374 | 68 | 2.0% | 882 |
| T3 | 57 | 1,974 | 98 | 5.0% | 1,277 |
| T2’ | 17 | 1,165 | 43 | 3.7% | 565 |
| NR3 | 44 | 8,843 | 118 | 1.3% | 1,534 |
| NR4 | 131 | 13,196 | 224 | 1.7% | 2,912 |
| Totals | 457 | 41,232 | 1,240 | 3.0% | 16,114 |

Table 91. Reduction in $CO_2$ Emissions from Reduced Use of Diesel Generators

| Item | Number | Unit | Reference |
|---|---|---|---|
| Reduction in number of back-up generators | 200 | | per Tt survey of 52 entities in Nepal |
| Gallons diesel burned /hour | 15 | Gallons | http://www.ehow.com/how_6023500_calculate-dioxide-emissions-diesel-generator.html |
| # of hours / day operation | 6 | hours | assumed load-shedding interruption of service |

[206] These estimates, considered conservative, are based on assumptions about what part of the community forests would be impacted. Actual borders of the community forests are not known as of this writing, but total areas are available. The “area impacted” was computed by finding the diameter of a circle whose area is the same as the given area for each CF and multiplying this length by the ROW width. It is recommended that these areas be better defined in the ESIA.

Table 91. Reduction in $CO_2$ Emissions from Reduced Use of Diesel Generators

| Item | Number | Unit | Reference |
|---|---|---|---|
| $CO_2$ emitted per gallon | 10 | Kg | http://www.ehow.com/how_6023500_calculate-dioxide-emissions-diesel-generator.html |
| **Reduction in annual $CO_2$ emissions** | **65,700** | **tonnes** | |
| **Calculations:** | | | |
| Heating value of low Sulfur diesel fuel (LHV) | 128,488 | BTU/gal | http://www.afdc.energy.gov/fuels/fuel_comparison_chart.pdf |
| Fuel/power efficiency of diesel engine used in small generators | 0.3 | | Tt estimate |
| Equivalence in terms of heat rate | 11,377 | BTU/kWh | |
| Energy equivalence conversion rate at 100% efficiency | 3,413 | BTU/kWh | |
| Calculation, kWh per gal of diesel | 11.3 | kWh/gal | |
| Hence the size of the referenced generator burning 15 gal/hr = | 169 | kW | |
| Hence the load replaced by 200 generators = | 33.9 | MW | |

It must be emphasized that mature forests at some point reach equilibrium between $CO_2$ capture (during growth) and release (when trees decay). Therefore, the planting of trees to capture $CO_2$ will only be effective as far as replacing the capture potential of the cleared trees plus their biomass and will not have a long-term effect of continuing to capture $CO_2$ after equilibrium is reached.

It should also be recognized that reductions in GHG may occur due to the project's lessening the need to use diesel back-up generators during load-shedding episodes and due to a possible reduction in emissions from coal-fired generation plants in India. These reductions should be quantified, if possible, in the final ESIA. An example calculation of the amount of $CO_2$ emission reductions from removing 200 back-up generators in Nepal is as shown in Table 91. The calculations show that the reduction in $CO_2$ emissions from the reduced use of diesel generators will be approximately four times the loss of $CO_2e$ capture from felled trees. This represents a positive impact. Additional studies should be carried out in the ESIA to ensure that all sources and sinks of $CO_2$ are properly accounted.

## 6.2 Benefit Sharing Opportunities

The PESIA team looked for opportunities for benefit-sharing and also looked at the risks the proposed project might face in development and implementation. Noting that the projects involve substation and transmission line construction, the key social risks to the project are largely related to resettlement issues, in which compensation for losses in lands and productive assets at substation sites and tower bases along the line right-of-way (ROW), will play a prominent part. While those risks will be addressed as part of preparation of the Resettlement Policy Framework, there are opportunities for both direct and indirect benefits. Employment and services delivery during construction offer direct benefits, but there may also be opportunities for indirect benefits that may accrue to those along the line ROW/corridor of impact if small development projects, such as those being considered for the proposed benefit-sharing program (see Annex F), can be implemented as

part of the proposed project, and thereby contribute to addressing gender and social inclusion problems.

The benefit-sharing program was not developed using a formal investigative methodology based on extensive field investigations. This is more appropriate to the conduct of the ESIA. The Concepts described as benefit-sharing opportunities are ideas that should be explored as Compact development progresses. Greenhouse technologies are well known and there are several projects financed by a variety of donors, although there has not a collective evaluation of those experiences. Brief discussions with a range of stakeholders were undertaken as part of the limited fieldwork of the Feasibility Study and were intended to obtain a general understanding of needs and priorities in the project areas; however, it will take detailed fieldwork to understand more clearly those needs and priorities and to determine the appropriateness of specific technologies in specific project areas. More precise cost estimates can then be made for relevant programs. This will be carried out during the development of the ESIA and is included in the ESIA TOR.

The approach taken for the PESIA borrowed from the “social ecology” model, which involves attention to the community through creating a descriptive approach for understanding informal as well as formal networks and routines; understanding human geography, or the ways that women, men and members of marginalized groups relate to their community and its areas; and management to creates alignment between stakeholder interests and the requirements of the infrastructure work. It will also take a specifically gendered, inclusive approach to establishing the SLO and to sharing benefits, in recognition of the fact that the most vulnerable groups in a society face cultural and institutional challenges to making their voices heard, and because men and women have different needs, interests and situations that cannot be approached in a gender-blind way.

Noting that the key constraint to benefit-sharing lies in the strict five-year horizon of the proposed compact, it is important that recommendations for development opportunities be designed and implemented as pilot demonstration projects that may be replicable with success during the compact period.

Concepts for several potential projects have been identified as an outcome of the site visits and field discussions. There is a specific focus of the proposals on women, especially those from disadvantaged groups, as their participation in activities with higher return is limited by i) lack of time, (ii) lack of access to economic assets and to marketing networks and technology, (iii) restricted mobility and risk-taking capacity, (iv) limited education and lack of vocational training, and (v) social discrimination on the part of employers. The concepts will attempt to address the challenges posed by (ii)-(iv). The concepts are described in Annex F, and estimated costs are presented in Section 8. That section also presents the suggestion that a system benefit charge (essentially a “tax”) of 5% of capital recovery cost be applied to cover benefit sharing costs.

## 6.3 Summary of Project-Level Impacts and Mitigation Measures

A summary of environmental impacts and mitigation measures is presented in Table 92, below. Project-specific impacts and potential mitigation measures for impacts are discussed in the subsections that follow. It should be noted that these environmental impacts and mitigation

measures are preliminary, to be refined in the final ESIA to the extent that they pertain after any alignment alterations that may occur during preliminary design.

Table 92. Summary of Environmental Impacts and Mitigation: Transmission Lines, Substations, Access Roads

| Environmental concern | Significant impacts without mitigation | Required mitigation measures (see detailed information in the ESMP) |
|---|---|---|
| **Detailed design phase** | | |
| Hydrological Impacts | Untreated runoff or wastewater negatively affecting quality or flows of water courses | Design/construct and maintain drains and retention structures to eliminate impact |
| Wetlands | Small areas of disturbance. Potential negative impacts to these habitats. | Routing avoidance; slit screens; restoration post-construction |
| Accessibility | Impacts unlikely | MAPF; disabled access provided |
| Soil Erosion | Earth borrows quarries and disposal for access roads and towers. Erosion and impacts to water courses. | Use existing borrow & disposal pits; erosion protection measures |
| Impact of Borrow Pits, Quarries and Waste Disposal | Unlikely to need new facilities. Erosion and habitat impacts could occur. | Obtain proper offsite permits from local officials, and document all locations and permits |
| Landslides | Possible on ridges. Improper tower siting may cause landslides. | Follow Nepal landslide prevention standards. Landslide mitigation considers earthquake and flood induced landslides. |
| Safety | Issues always likely. Workers and local populations exposed to construction hazards. | Fences, signs, and all applicable design safety standards; community awareness training |
| ROW Environmental Impacts | Scattered areas of critical habitat may be encountered. Potential negative impacts to these habitats. | Avoid tower placement in areas of critical habitat; install transmission lines above vegetation; limit construction during breeding season; remove invasive species; integrated vegetation management. *(Note A)* |
| Aquatic Habitat | Line will cross occasional wetlands and fish habitat. Potential negative impacts to these habitats. | Avoid siting towers in wet areas; use clear span bridges for access roads, open bottom culverts; minimize disturbing riparian vegetation. *(Note A)* |
| Electric and Magnetic Fields (EMF) | Potential exposure when crossing inhabited areas. Impacts of EMF not clear, so should be avoided. | Evaluate exposure according to standards of International Commission on Non-Ionizing Radiation Protection (ICNIRP); if below standards, implement protective engineering measures. *(Note A)* |
| Visual Aesthetic Values | Transmission lines and towers along the valleys and on ridges in the Middle Hills and Tarai area would reduce scenic beauty and attraction for | Wherever possible, the design should place the lines below the ridgeline of the mountains to avoid protrusion of towers and lines, and enable the transmission line profile to merge with the existing landscape. |

Table 92. Summary of Environmental Impacts and Mitigation: Transmission Lines, Substations, Access Roads

| Environmental concern | Significant impacts without mitigation | Required mitigation measures (see detailed information in the ESMP) |
|---|---|---|
| | tourists. The overall magnitude of impact is considered to be low, its extent local, but its duration long term. | |
| **Construction phase** | | |
| Inadequate environmental awareness of workers | Likely to be instances with subcontractors, leading to violations of the ESMP requirements | Contractors to retain environmental health & safety officers. Conduct special and regular briefings and trainings. *(Note B)* |
| Water Quality | Temporary impacts highly likely from spillages, wastewater disposal, and onsite solid waste disposal. Could affect surface or groundwater. | Operator training; maintain lubricant and fuel storage facilities and procedures; properly designed drainage system; 50m standoff of facilities and construction from receiving water bodies; onsite dumping prohibitions; vehicle and machine maintenance enforced; sanitation facilities and wastewater treatment at work sites and construction camps. |
| Air Quality/Dust | Likely only at substation construction sites. Increased levels of respirable particulate matter above health-related standards leading to health issues for workers or local populations. | All machinery to be fitted with air quality control equipment to IFC and national standards; use Euro IV diesel fuel when available; enclosing sand stockpiles & wind barriers; providing all-weather roads where there is regular vehicle movement; wetting of other roads; closed storage of cement materials and aggregate; fuel efficient vehicles, idle engine turnoff; onsite vehicle washing; dust control measures. |
| Noise/Vibration | Exceedance of standards likely at substations and temporarily at tower construction sites, especially where piles need to be driven. | Noise abatement gear for vehicles and powered mechanical equipment; daylight operation restriction near populated areas; maintenance of equipment and vehicles, especially mufflers; speed controls; acoustic screens near sensitive receptors (schools, temples, etc.). |
| Soil Erosion and soil contamination | Likely at substations and tower construction sites (temporary) | Complete drainage works to be designed and maintained; strengthen steep slopes; proper disposal of extracted soils; avoid use of arable land for borrow and fill; restoration of cover as soon as feasible. |
| Handling and Storage of Hazardous Materials | Unlikely, and limited to construction yards | Constructed storage areas on impermeable surfaces; safe ventilation practices; controlled access procedures; use of refrigerants and fire extinguishing materials in accord with the “Montreal Protocol.” |

Table 92. Summary of Environmental Impacts and Mitigation: Transmission Lines, Substations, Access Roads

| Environmental concern | Significant impacts without mitigation | Required mitigation measures (see detailed information in the ESMP) |
|---|---|---|
| Landslides | Possible but unlikely | Use of landslide prevention measures; careful use of excavation equipment so as not to destabilize topsoil layers. |
| Damage to Historic/Cultural Monuments | Unlikely after studies during detailed design are complete | Training of workers in artifact recognition; immediate cease work provisions in case of finds; prior coordination with Ministry of Culture regarding procedures; documentation of findings; rarely, design avoidance/preservation features. *(Note C)* |
| Work Camp/ Temporary Yard Operation and Location | Wherever present. Possible tree cutting; water & sanitation impacts; solid and hazardous waste releases; failure to maintain waste separation, collection & transport away from site; failure to restore / revegetate the site | Avoid settlements where possible; avoid tree cutting; provide water & sanitation; manage solid, hazardous waste and sewerage; maintain waste separation, collection & transport away from site; site restoration, re-vegetation; inspect & validate that site is returned to pre-project conditions |
| Worker safety | Wherever present. Workers exposed to construction hazards. | Engineer-approved EHS plan, to include: warning signs; personal protective equipment; worker training; vehicle & equipment training, licensing; first aid and medevac transport available; regular safety checks; maintian24-hour emergency contact lists; provide HIV/AIDS & STD awareness training and testing. |
| Traffic management and construction safety | At all construction sites, long term or short term. Traffic-related accidents and congestion in roads used during construction. | Prepare & enforce traffic management plan, to include, *inter alia,* traffic warning signs and regulations enforcement; awareness program; traffic control personnel/flaggers; alternative pedestrian access; arrange passer-by safety; select quarry and borrow sites with capacity for heavy trucks; vehicular speed control; road damage repair; local authority approval for use of local roads |
| **Operation phase** | | |
| Bird Protection | All valley crossings & designated flyways. Significant bird mortality due to collisions with conductors or towers. | Install reflectors on all transmission line major river crossings and in areas of frequent fog. Plant tall growing trees outside ROW to encourage birds to fly higher and avoid trees and lines; include nest and resting platforms on towers for raptors and vultures. *(Note A)* |
| ROW Maintenance | Throughout route, and especially through community forests. Improper maintenance of the ROW leading to potential vegetation reaching | Develop and implement vegetation management plan to provide local job opportunities, especially women and vulnerable people. Avoid use of pesticides and herbicides where possible; otherwise, train & certify personnel in safe application procedures. |

Table 92. Summary of Environmental Impacts and Mitigation: Transmission Lines, Substations, Access Roads

| Environmental concern | Significant impacts without mitigation | Required mitigation measures (see detailed information in the ESMP) |
|---|---|---|
| | too close to the conductors. Increased erosion on steep slopes. Potential use of herbicides could affect nearby agricultural lands or water courses. | |

*Notes*

A. Detailed location and extent of problem areas shall be determined during preliminary design phase.
B. Individual contractors shall be asked to fill in questionnaire to be prepared and administered by client environmental health and safety officer.
C. All known sites have been avoided during feasibility studies. Further site investigation will be needed during detailed design phase and prior to construction.

### 6.3.1 NR1

**Environmental Impacts and Mitigation Measures**

NR1 is an extensive 400 kV trunk line covering almost all Nepal physiographic zones, low mountains, mid-hills to tarai. A general summary of anticipated impacts and mitigation is presented in Table 92

Naubise SS - Lapsephedi SS segment

- Routing explicitly avoids Shivapuri Nagarjun National Park boundary and stays at least 1-2 km outside buffer zone.
- Access road to Lapsephedi SS will require more intensive E/S examination and special ESMP section.
- Avoids most settled areas, forests and intensive agriculture and aquaculture (many fish ponds). Important source of Nepal fresh vegetable supply.
- Avoids the Chisapani-Kakani trekking and fishing conjunction.
- Wildlife corridors and migratory bird flyways require special consideration and mitigation measures, particularly for bird collisions.
- Through community forests, minimized impact by inserting more angle points.
- Crosses some fragmented forest areas. Many leasehold forest possibilities (benefit sharing).
- Potential visibility/aesthetic issues in some locations with negative touristic impacts near popular international trekking paths.
- Alignment tends to follow roads where possible in order to utilize part of ROW, minimize new ROW acquisition.
- Line jumps gullies and valleys where feasible to minimize towers in flood plain or river.

Hetauda SS – Naubise SS segment

- In the Siwalik, slopes are susceptible to undercutting and erosion. Mitigation measures required where line transects, particularly on ridges.

- Wildlife, in some cases leopards, not impacted by line, rather present a conceivable problem for laborers
- Some land acquisition issues primarily at Hetauda depending on substation footprint and final siting. Most impacts avoidable.

Naubise SS to New Damauli SS to New Butwal segment

- New Butwal area, last approach from north, slopes highly erodible. Mitigations measures should be well enforced.
- Kali Gandaki River crossing, bird reflectors and other mitigation measures to be employed.
- Line avoids unique habitat in Siwaliks by 10-15 km: migrating rhinos, tigers, elephants
- Bird corridor for about 30 km east of Damauli requires reflectors, other mitigation measures
- Sal, sishu hardwoods and acacia species mostly avoided.
- CHAL Wildlife corridors and migratory bird flyways require special consideration and mitigation measures, particularly for bird collisions.

**Socio-Economic Impacts**

**Chitwan District**

With only one VDC affected, the social and gender impacts of the transmission line are limited. However, with extensive forest cover, particular attention will have to be given to addressing the concerns of forest users whose access to NTFPs may be restricted by the transmission lines and who may face losses owing to the ROWs established for the lines. This will include assessing the extent to which local women depend upon NTFPs for immediate domestic use and livelihoods, as well as their levels of awareness of the impacts of the transmission lines on local forests.

**Dhading District**

The proposed line runs through 11 VDCs with about 105,000 persons located in the southern part of the District. While there will be impacts in loss of access to agricultural lands, the area is better off than the poorer northern areas, and will not be significantly impacted. The Naubise substation is located in the District and aside from the customary impacts associated with new construction, which will be addressed by implementation of the ESMP, will likely create beneficial impacts in employment creation and opportunities for provision of services, the latter an avenue for income generation by women.

**Kathmandu District**

The principal impacts relate to the construction of the substation at Lapsiphedi, which will require acquisition of lands and access road improvements. Construction activities for the new substation will involve the presence of a large labor force, largely foreign (non-local), who will be at a construction camp for several months, and hence, likely to be involved with local populations. Contract clauses will be required to ensure that not are community relations harmonious, but that there is clear understanding of the need by construction to respect local social norms and practices, including addressing their awareness on HIV/AIDS, STD, TIP and child labor. On a positive note, the substation will offer qualified members of the community the opportunity for employment and provision of services, the latter particularly attractive to women's groups. With heavy construction traffic on the road to Lapsiphedi, there will be a need to increase road safety measures.

**Makwanpur District**
Project activities will not have significant social and gender impacts in this District. The customary health, safety and community relations measures associated with new construction will need to be set in place. Aside from encouraging engagement of qualified local populations where practicable, contractor clauses will include provisions to deal with local community relations, communicable diseases, safety, TIP, and employment and workplace conditions.

**Sindhupalchok District**
The line will not have significant impacts from a social and gender perspective. However, given the high poverty levels in the district, construction activities along the line could offer employment and service provision opportunities to local populations, including women.

**Nuwakot District**
The transmission line will not have significant effects except in the clearing of forest area ROWs, for which attention will be paid in the ESMP.

**Tanahu District**
The New Damauli substation is located in Tanahu District. The principal impacts relate to the construction of the substation. which will involve the presence of a large labor force, largely foreign (non-local), who will be at a construction camp for several months, and hence, likely to be involved with local populations, negative interaction with which have to be avoided. The substation will offer qualified members of the community the opportunity for employment and provision of services, the latter particularly attractive to women's groups. Construction traffic will necessitate the need to increase road safety measures. The social and gender issues are much the same as those in Sindhupalchok.

**Palpa District**
A hill district, there are likely to be more concerns in the project-affected VDCs associated with loss of limited available productive lands that will be addressed as part of the resettlement planning and implementation component. The project-affected VDCs are identified in Annex E. Field-level investigations that will provide detailed information on the VDCs will be carried out during the preparation of the ESIA.

**Nawalparasi District**
Construction activities will be associated with the New Butwal substation. Aside from the customary impacts associated with new construction, which will be addressed by implementation of the ESMP, will likely create beneficial impacts in employment creation and opportunities for provision of services, the latter an avenue for income generation by women. The customary health, safety and community relations measures associated with new construction will need to be set in place. Aside from encouraging engagement of qualified local populations where practicable, contractor clauses will include provisions to deal with local community relations, communicable diseases, safety, and employment and workplace conditions

### 6.3.2 XB1

**Environmental Impacts and Mitigation Measures**

The short XB1 route is entirely located in the tarai, and there is literally no path between the substation termini that will not traverse extensive tracts of agricultural land. Intensive irrigated farming is abundant throughout the area, primarily rice paddies, as well as, especially in winter, potato, wheat, and mustard. The few urbanized areas such as Harpur are avoided, and settlement impacts are few. Forest areas are rare except along watercourses and wetlands, and these also are avoided or overpassed by the lines, with often maximum spacing between towers. No indigenous populations are noted in the area of influence.

As the route approaches the Indian border, population density increases, and when an exact location for the line terminus in India is determined, the final ESIA will need to address potential added impacts and mitigations. For present purposes, the standard set of impacts and mitigations presented in Table 92 is sufficient to address any concerns.

**Socio-Economic Impacts**
Nawalparasi District: The principal impact of project activities is likely to be loss of productive lands, which will be addressed as part of the RAP planning and implementation process.

### 6.3.3 T8

**Environmental Impacts and Mitigation Measures**
Similar in terms of purpose and geography to the XB1 project, the relatively short T8 transmission line, with substation at New Lamki, is intended to connect to a location at the Indian border, that is lightly shown in yellow in the bottom left of Figure 48 Although most of the route is through the tarai and passing over agricultural lands while avoiding settlements as much as possible, the first part of the northern end of the route must cross within the edge of a community forest. See Figure 48 right panel. The line must avoid being sited in the flood plain (pale tan area in photos), forcing a cut through the forest along its edge. The standard set of impacts and mitigations presented in Table 92 addresses environmental concerns for this project.

- Needs careful assessment of trees to be cut in community forest, and appropriate compensation under established rules, in cooperation with CFUG.
- Lands traversed in the tarai area are given over to intensive agriculture, rice paddy cultivation, plus wheat, mustard and sugar cane.
- Small, scattered settlements. Homestead vegetable plots. Route avoids most structures.
- As the route approaches border, population density increases and settlement impacts may increase proportionately. Mohana River is the border.

**Socio-economic Impacts**
**Kailali District***:* The District will see the construction of one new substation (New Lamki) and rehabilitation of another (Attariya). The new substation will be constructed in a densely-populated region, so, aside from RAP concerns, attention will be paid in the ESMP to noise, safety, campsite management, and other construction-related issues. The substation may be able to offer employment opportunities to qualified local residents. The customary health, safety and community relations measures associated with new construction will need to be set in place. Aside from encouraging engagement of qualified local populations where practicable, contractor clauses will

include provisions to deal with local community relations, communicable diseases, safety, and employment and workplace conditions


**Figure 48. Left: T8 Project Alignment. Right: Detail of Forest at Northeastern End of Alignment.**

### 6.3.4 T3

**Environmental Impacts and Mitigation Measures**

The T3 is a relatively short line, 30 km, situated in rugged mountainous terrain, connecting a new substation to be constructed at Tadhekani with a substation at Kusma where no land is to be acquired. From an environmental point of view, the goals were to avoid population centers while minimizing intrusion on limited agricultural lands and skirting forests.

**Figure 49. Left: T3 Alignment, Plan View. Right: Route Section Shows Difficulties of Terrain**

- Crosses Myagdi River upon leaving Tadhekani, crosses the Gandaki River three times at height, and parallels the road in riverine gorges to extent possible.
- Vegetation is smaller or stunted on heights.
- Limitations on elevation of power line in order to avoid corona losses, forces alignment down toward river valleys, agricultural, and settlements, to be avoided if feasible.
- Pine forests in several locations.
- Kalika temple is far to the southwest; no impact to it and its sacred forest.

Figure 50 illustrates the preferred transmission line alignment (red line), near a main road, that avoids settlements and splitting agricultural lands, minimizes forest intrusion, and avoids siting in the flood plain of rivers, in this case the powerful Gandaki River.

The standard set of impacts and mitigations presented in Table 92 addresses environmental concerns for this project.


**Figure 50. Example of Multidisciplinary Micro-Siting for T3 Project**

**Socio-economic Impacts**

**Myagdi**: Project activities will not have significant impacts in this district, particularly as it has very low population density.

**Parbat**: There will be construction activities at two substations in the District (Tadekhani, Kusma). Aside from the customary impacts associated with new construction, which will be addressed by implementation of the ESMP, will likely create beneficial impacts in employment creation and opportunities for provision of services, the latter an avenue for income generation by women. The customary health, safety and community relations measures associated with new construction will need to be set in place. Aside from encouraging engagement of qualified local populations where

practicable, contractor clauses will include provisions to deal with local community relations, communicable diseases, safety, and employment and workplace conditions.

### 6.3.5 T2'

**Environmental Impacts and Mitigation Measures**

This is an approximately 50 km-long 220 kV new transmission line from Khimti SS to Likhu Hub SS. It crosses from one river valley to another through rugged territory and over a ridge top at nearly 2,800 meters. A new access road may need to be built roughly parallel to the route, and this is likely to cause impacts greater than those investigated for the transmission line. Transmission line impacts of note are listed below.

**Red Panda (*Ailurus fulgens*)**

- Sub-alpine environment requires more detailed treatment in the final ESIA.
- Most of the widely-scattered settlements and structures are avoided by the alignment.
- However, extensive tracts of forest, much highly degraded but including community forests, are inevitably impacted by preferred alignment and any alternative.
- Deviations in the most direct route have been made in order to avoid transecting patches of red panda habitat. It should be noted that presence of habitat is not evidence of presence of red pandas (*Ailurus fulgens*, not really a panda). Nevertheless, the preferred route avoids these areas.
- Further deviations from the LRT route were made along ridge tops to stay clear of areas of high landslide potential.
- Final ESIA should check the Khimti to Rasnalu area where Dhasinghare (*Gultheria fragrantissma*) bushes containing essential oils such as camphor are found.
- Degraded community forest, may be leasehold forest, in Ramechhap district.
- Hayu, Sunwar ethnic group in Priti VDC area, but not affected by Tx route
- Snowfall in upper part of Rasnalu hiking area, which is not affected.

The standard set of impacts and mitigations presented in addresses environmental concerns for this project.

**Socio-economic Impacts**

**Ramechhap District:** There will be construction activities at the New Khimti substation. Aside from the customary impacts associated with new construction, which will be addressed by implementation of the ESMP, will likely create beneficial impacts in employment creation and opportunities for provision of services, the latter an avenue for income generation by women. The customary health, safety and community relations measures associated with new construction will need to be set in place. Aside from encouraging engagement of qualified local populations where practicable, contractor clauses will include provisions to deal with local community relations, communicable diseases, safety, and employment and workplace conditions

**Dolakha District**: Project activities will not have significant impacts in this District.

**Solukhumbu District:** There will be construction activities at the Likhu substation. Aside from the customary impacts associated with new construction, which will be addressed by implementation of the ESMP, will likely create beneficial impacts in employment creation and opportunities for provision of services, the latter an avenue for income generation by women. The customary health, safety and community relations measures associated with new construction will need to be set in place. Aside from encouraging engagement of qualified local populations where practicable, contractor clauses will include provisions to deal with local community relations, communicable diseases, safety, and employment and workplace and employment conditions that are gender-sensitive.

### 6.3.6 NR3

**Environment Impacts**
The environmental setting for NR3 is in the heavy monsoon area of Nepal, and susceptible of erosion. Mitigation measures for erosion and precipitation-induced landslide are a primary consideration throughout the route.

- North of Inaruwa SS, the route runs through farming country, mainly rice paddies and into sensitive Siwalik areas, but avoids a Ramsar site, birding area and a national park. It is near an annual wild elephant corridor (no impact), and wild buffalo, leopards, jackals and other wildcats are known to pass through the area annually or from time to time.
- The route touches on some community forest area as it skirts around the large municipality of Dharan, population 1.6 million, and again west of Baguwa. East of Dharan was “6-km-wide forest, now highly fragmented.”
- Tea gardens in the Ilam SS area are to be avoided. Otherwise, there are few issues, and the summary of environmental impacts and mitigation shown in Table 92 will address most concerns.

**Socio-economic Impacts**
**Ilam District**: There will be construction activities at the Ilam substation. Aside from the customary impacts associated with new construction, which will be addressed by implementation of the ESMP, will likely create beneficial impacts in employment creation and opportunities for provision of services, the latter an avenue for income generation by women. The customary health, safety and community relations measures associated with new construction will need to be set in place. Aside from encouraging engagement of qualified local populations where practicable, contractor clauses will include provisions to deal with local community relations, communicable diseases, safety, and employment and workplace conditions.

**Morang District**: Project activities will not have significant impacts in this District.

**Sunsari District:** There will be additional construction activities at the Inaruwa substation. Aside from the customary impacts associated with new construction, which will be addressed by implementation of the ESMP, will likely create beneficial impacts in employment creation and opportunities for provision of services, the latter an avenue for income generation by women. The

customary health, safety and community relations measures associated with new construction will need to be set in place. Aside from encouraging engagement of qualified local populations where practicable, contractor clauses will include provisions to deal with local community relations, communicable diseases, safety, and employment and workplace conditions.

### 6.3.7 NR4

**Environmental Impacts**
The NR4 consists of adding a single 132 kV circuit to a pre-existing double-circuit transmission line that is currently strung with only one circuit. No new towers or construction along the alignment are contemplated. There are, however, unresolved issues regarding land tenure and compensation within the existing ROW along some sections of the route that remain to be clarified and resolved. Trees cut during the original alignment have re-grown in places, and will have to be cut or trimmed to make way for the new line, which will be hung within the existing 18-meter wide ROW, in the 9 meters from centerline.

An EIA for the existing line was prepared under Nepal environmental regulations.[207]

Apart from the above, the remaining environmental impacts to be addressed concern the effects, if any, of additional electric and magnetic fields (EMF), and temporary access to towers during the stringing of new line. There may also be localized construction impacts at the Attariya and/or Blanch substations as those are retrofitted to accept the new line.

**Socio-economic Impacts**
**Bataidi District**: Project activities will not have significant impacts in the area given double stringing along an existing line. However, given the extensive forest cover in the region, attention will be paid to any loss of access to forest products or incomes lost owing to the establishment of the ROW. There may be limited opportunities for employment or service provision along the lines.

**Dadeldhura District:** Project activities will not have significant impacts in the area given double stringing along an existing line. However, given the extensive forest cover in the region, attention will be paid to any loss of access to forest products or incomes lost owing to the establishment of the ROW. There may be limited opportunities for employment or service provision along the lines.

**Darchula District:** There will be construction activities at the Balanch substation. Aside from the customary impacts associated with new construction, which will be addressed by implementation of the ESMP, will likely create beneficial impacts in employment creation and opportunities for provision of services, the latter an avenue for income generation by women. The customary health, safety and community relations measures associated with new construction will need to be set in place. Aside from encouraging engagement of qualified local populations where practicable, contractor clauses will include provisions to deal with local community relations, communicable diseases, safety, and employment and workplace conditions.

[207] Shah Consult International (p.) Ltd. 2008. Environmental Impact Assessment of Balanch - Attariya 132 kV Transmission Line Project, March, 2008, report prepared for Nepal Electricity Authority, Kathmandu.

**Doti District:** Project activities will not have significant impacts in the area given double stringing along an existing line. However, given the extensive forest cover in the region, attention will be paid to any loss of access to forest products or incomes lost owing to the establishment of the ROW. There may be limited opportunities for employment or service provision along the lines.

**Kailali District:** Project activities will not have significant impacts in the area given double stringing along an existing line in this part of Kailali. However, given the extensive forest cover in the region, attention will be paid to any loss of access to forest products or incomes lost owing to the establishment of the ROW. There may be limited opportunities for employment or service provision along the lines.

## 6.4 Potential Fatal Flaws

Fatal flaws for the PESIA were defined as project-related effects that did not comply with any of the IFC Performance Standards even with mitigation. The environmental assessment did not identify any fatal flaws.

# 7. Analysis of Alternatives

This section provides a brief description of the alternatives to the proposed lines and substations that have been considered, given that the designs are still at a very preliminary stage. In general, alternatives consist of the following:

- "Preferred alternatives," which are the projects defined using the multi-criteria analysis followed by the PLS-CADD design. The process considered many variations in the line routings to minimize or avoid impacts for each of the lines. The "final" lines are discussed in detail in Section 6.
- "Initial alternatives," which were lines and substation locations defined by the MCC due diligence technical consultants based on desk studies performed by NEA.
- "No action," which implies that the projects would not be performed under the MCC compact.

There are also design alternatives which have been considered during the feasibility level design. These are primarily dealing with technical options such as the use of AIS or GIS in the substations, the types and height of towers, and other technical features. These engineering features do not substantially change the results of the assessments provided in Chapter 6 and are not explored further in the PESIA. However, it is recommended that they be looked at carefully during the preliminary design stage in the full ESIA to see if there are some environmental advantages (such as, for example, smaller footprints for the substations) or disadvantages (such as the need to modify streams or do extensive excavations).

## 7.1 Initial Alternatives

The principal difference between the preferred and initial alternatives is that the preferred alternatives were developed using a multi-criteria analysis which sought to reduce or eliminate environmental and social impacts and the need for resettlement. The figures that follow compare the "initial" to the "preferred" alternatives for each of the projects, except for NR4 which is an existing line.

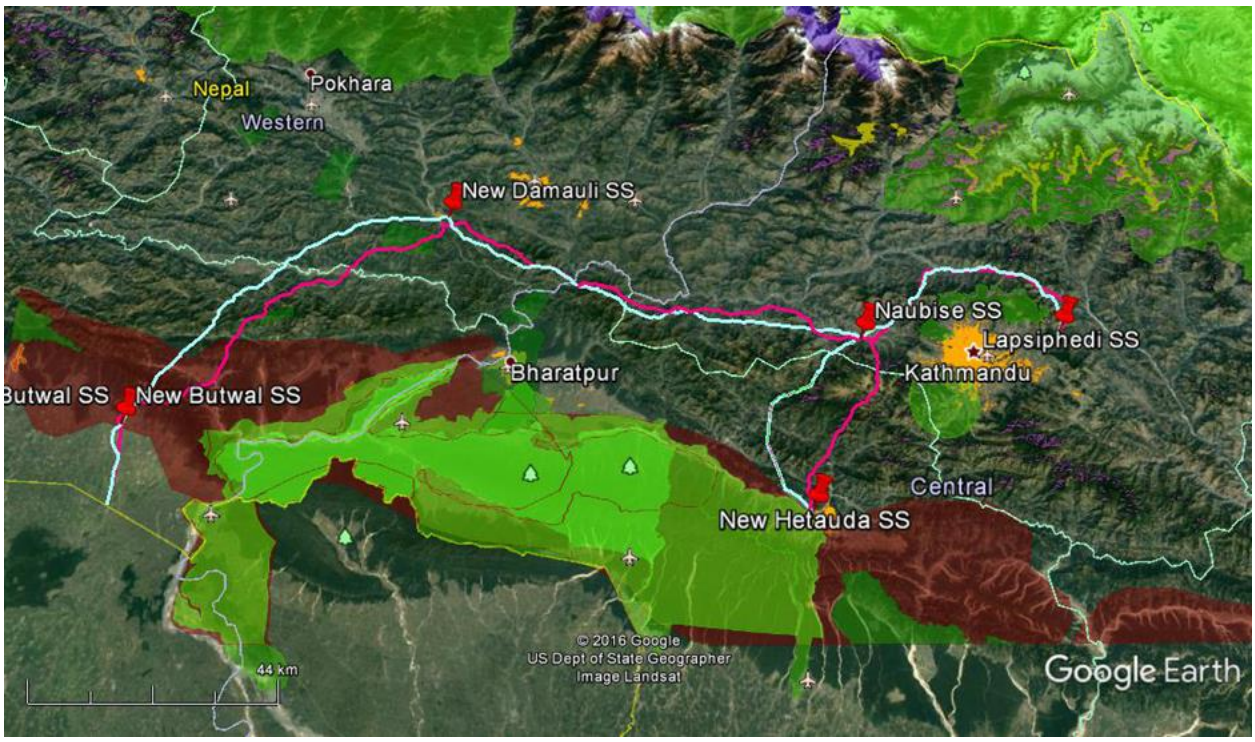


**Figure 51. Comparison of "Preferred" Alternative (light blue) to "initial" Alternative (red) for NR1 and XB1**

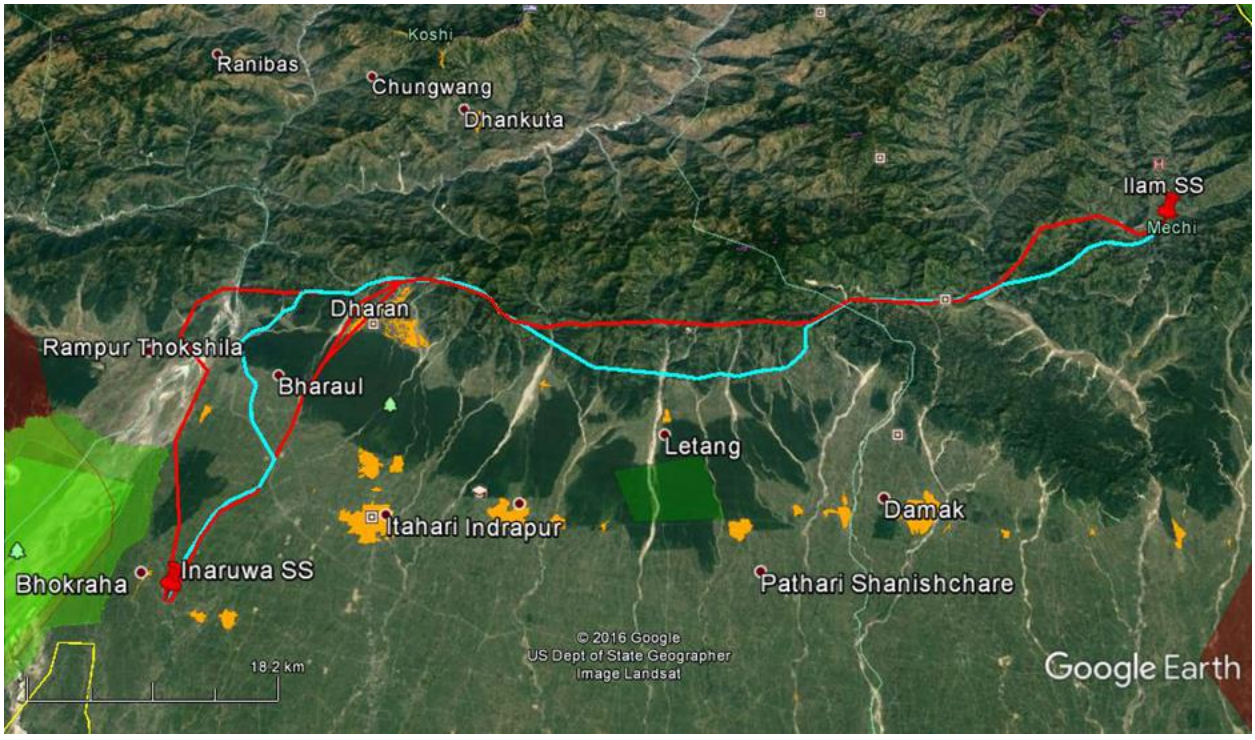


**Figure 52. Comparison of "Preferred" Alternative (light blue) to "Initial" Alternative (red) for NR3**

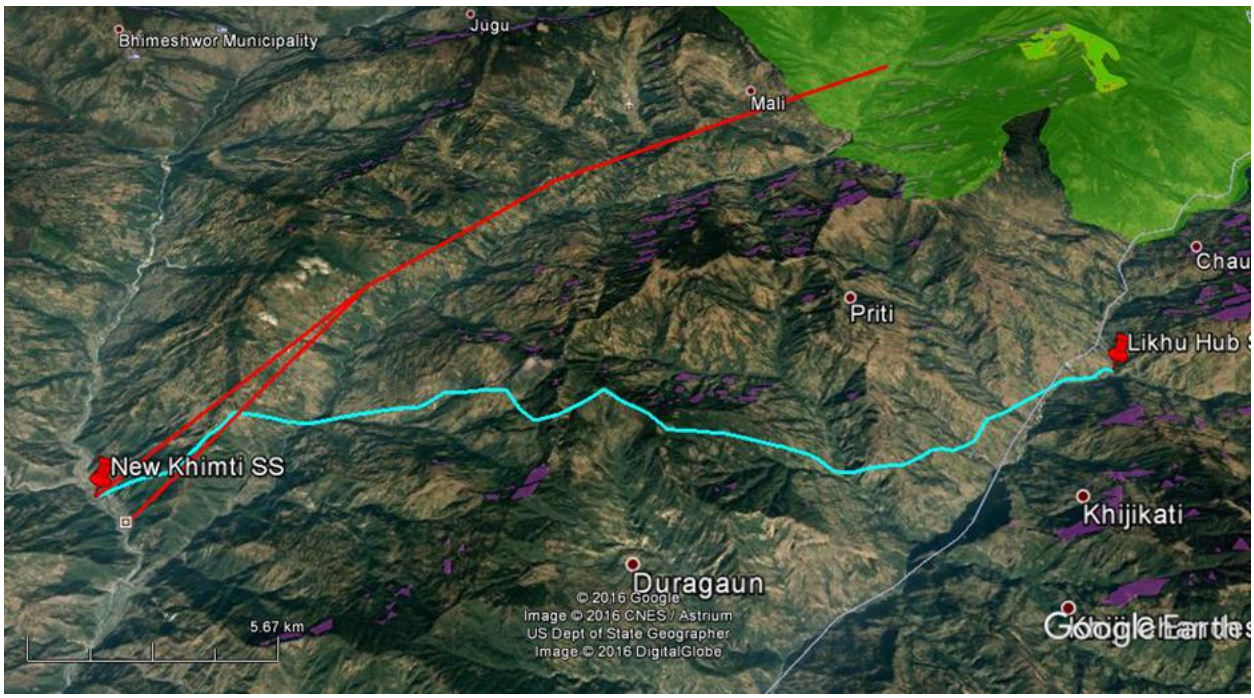


**Figure 53. Comparison of "Preferred" Alternative (light blue) to "Initial" Alternative (red) for T2'**

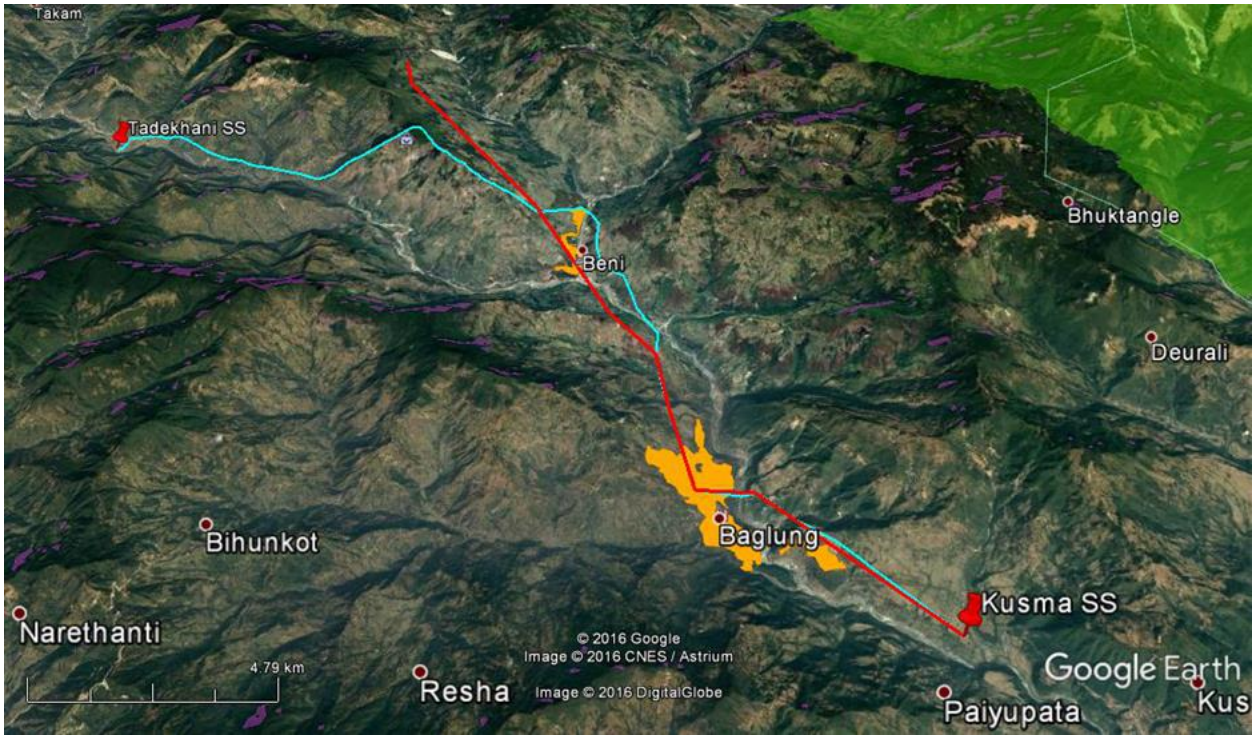


**Figure 54. Comparison of "Preferred" Alternative (light blue) to "Initial" Alternative (red) for T3**

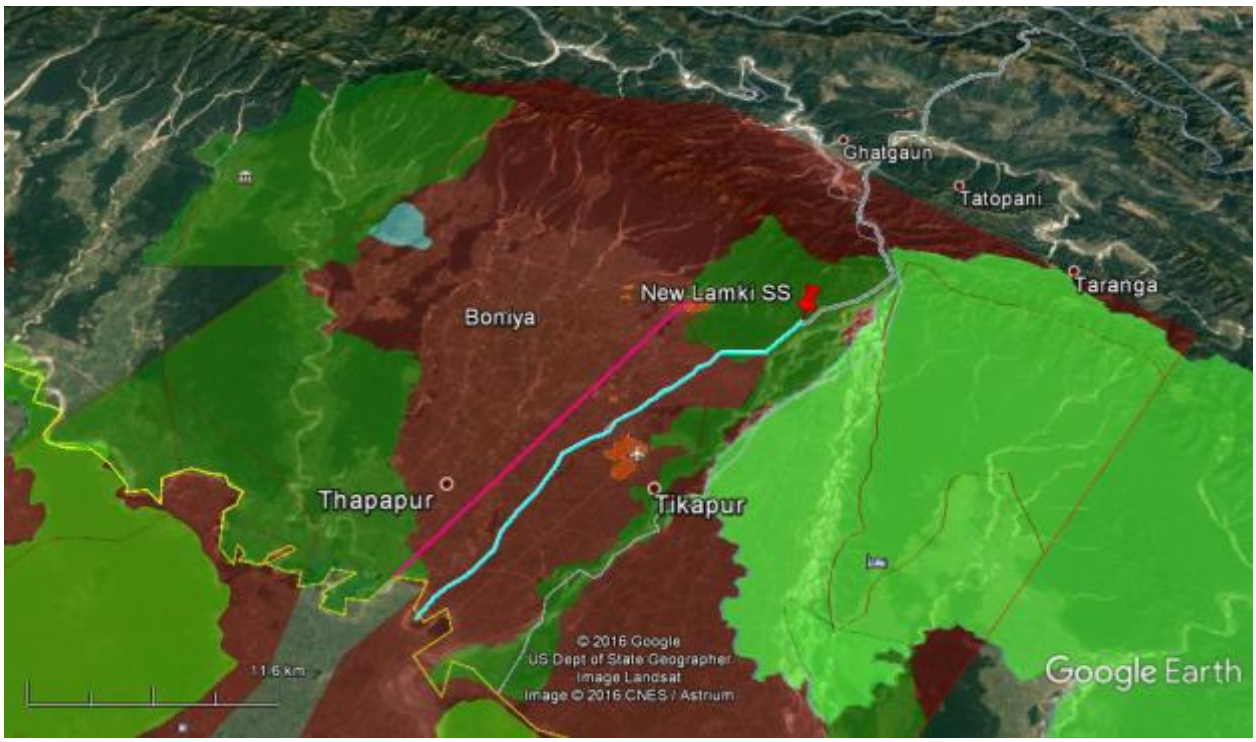


**Figure 55. Comparison of "Preferred" Alternative (light blue) to "Initial" Alternative (red) for T8**

## 7.2 No Action Alternatives

The "no action" alternatives for each of the projects will have the effect of eliminating the benefits (national, regional, and local) that are expected from the projects. This would include the economic and fiscal benefits to the country of being able to sell power to India.

Because the transmission lines are part of a master plan for electrification of the country it is expected that these lines, or other very similar ones will be constructed at some point in the future. Any negative impacts therefore would only be postponed to a later date. Nepal is growing and urban areas are expanding, so social and resettlement impacts can be expected to increase in severity in the future.

# 8. Environmental Management

## 8.1 Outline for an Environmental and Social Management System

An environmental and social management system (ESMS) is designed to set policy and specific measures for mitigating adverse impacts and monitoring compliance with the Nepalese and international E/S performance standards for large infrastructure projects. The ESMS for the MCC Nepal program is being developed by MCC's ESP due diligence consultants and will be applied to the activities of the GoN organization responsible for the implementation of the compact projects. The FS consultants recommend that the ESMS contain, at a minimum, the items presented in the table below.[208]

Table 93. Recommended Contents of the ESMS

| Preliminary Draft Outline of the ESMS | |
|---|---|
| **I.** | **INTRODUCTION**<br>Should describe the purpose and scope of the ESMS. The ESMS will apply to all projects financed by MCC. |
| **II.** | **ENVIRONMENTAL AND SOCIAL MANAGEMENT POLICY**<br>The policy must describe the framework for the environmental and social assessment and management process, and specifies that the project will comply with the applicable laws and regulations of Nepal, including those laws implementing Nepal's obligations under international law. The policy will also be consistent with the IFC Performance Standards. The Policy should also specify who will bear the responsibility to implement the ESMS. |
| **III.** | **IDENTIFICATION OF RISKS AND IMPACTS**<br>The ESMS will establish and maintain a process for identifying the environmental and social risks and impacts of the project, including the type, scale, and location of the projects. In the case of the potential MCC compact projects a full ESIA is scheduled to be completed in 2017 and this effort will provide insights into the risks and impacts. In addition, the ESMS will establish an environmental and social due diligence process that will identify risks and impacts at points in the future when the potential current or future projects are reasonably understood. The process will consider all relevant direct, indirect and cumulative environmental and social risks and impacts of the project, including the issues identified in IFC Performance Standards 2 through 8, and those who are likely to be affected by such risks and impacts. |
| **IV.** | **MANAGEMENT PROGRAMS**<br>The ESMS will establish management programs that will describe mitigation and performance improvement measures and actions that address the identified environmental and social risks and impacts of the projects. The management programs may consist of a combination of operational |

[208] Based on IFC 2012. "Guidance Note 1 Assessment and Management of Environmental and Social Risks and Impacts." January 1, 2012

Table 93. Recommended Contents of the ESMS

| Preliminary Draft Outline of the ESMS |
|---|
| procedures, practices, plans, and related supporting documents (including legal agreements) that are managed in a systematic way. The programs should apply across the entity's organization, including contractors and primary suppliers over which the organization has control or influence. The management programs will establish environmental and social Action Plans which will define desired outcomes and actions to address the issues raised in the risks and impacts identification process, as measurable events to the extent possible, with elements such as performance indicators, targets, or acceptance criteria that can be tracked over defined time periods, and with estimates of the resources and responsibilities for implementation.<br><br>**V. ORGANIZATIONAL CAPACITY AND COMPETENCY**<br>In addition to clear organizational responsibilities, those overseeing the environmental and social performance of the projects will have the knowledge, skills, and experience necessary to perform their work, including current knowledge of Nepal's regulatory requirements and the applicable requirements of IFC Performance Standards and MCC. Training programs will be carried out to enhance the capabilities of the ESP personnel. All groups or departments within the entity will be required to abide by the ESMS. The entity may use suitably qualified in-house staff or consultants to ensure that the ESMS is properly implemented. Qualified external experts are usually required on issues concerning resettlement (as provided in Performance Standard 5), biodiversity (as provided in Performance Standard 6), Indigenous Peoples (as provided in Performance Standard 7) and cultural heritage (as provided in Performance Standard 8).<br><br>**VI. EMERGENCY PREPAREDNESS AND RESPONSE**<br>The ESMS will include an emergency preparedness and response system so that the entity can respond effectively to emergency situations. Detailed guidance on emergency preparedness and response is provided in the World Bank Group Environmental Health and Safety (EHS) Guidelines, whether in the General EHS Guidelines or in the Industry Sector EHS Guidelines[209]. Recent experience in Nepal indicates that members of the public have been at risk of electrocution from accidents on or near transmission lines. Therefore, the emergency response plan outlined below should include response to accidents to the public, not just the workers:<br><br>▪ Identification of the emergency scenarios<br>▪ Specific emergency response procedures<br>▪ Trained emergency response teams<br>▪ Emergency contacts and communication systems/protocols<br>▪ Procedures for interaction with government authorities<br>▪ Permanently stationed emergency equipment and facilities and protocols for its use<br>▪ Clear identification of evacuation routes and muster points<br>▪ Emergency drills and their periodicity based on assigned emergency levels or tiers<br>▪ Decontamination procedures and means to proceed with urgent remedial measures to contain, limit and reduce pollution within the physical boundaries of the project property |

[209] for example, IFC 2007. "Environmental, Health, and Safety Guidelines - Electric Power Transmission and Distribution," April 30, 2007

Table 93. Recommended Contents of the ESMS

| Preliminary Draft Outline of the ESMS |
|---|
| and assets to the extent possible.<br><br>**VII. STAKEHOLDER ENGAGEMENT**<br>Stakeholder engagement should follow the Stakeholder Engagement Framework (SEF) developed during compact Development and be in force over the life of the compact. The SEF will allow the views, interests and concerns of different stakeholders, particularly of affected communities to be heard, understood, and considered in project decisions and creation of development benefits.<br><br>**VIII. MONITORING AND REVIEW**<br>The ESMS will include procedures to monitor and measure the effectiveness of the ESMS, as well as compliance with any related compact, legal and regulatory requirements. If another party has responsibility for managing specific risks and impacts and associated mitigation measures (such as the Supervising Engineer's responsibility to monitor compliance with the ESMP), the entity will collaborate in supporting such measures. Where appropriate, representatives from Affected Communities or non-governmental organizations will be asked to participate in monitoring activities. The entity's monitoring program should be overseen by the appropriate level in the organization.<br><br>Annex A: Nepal Environmental Assessment Requirements<br>Annex B: MCC Environmental Guidelines<br>Annex C: IFC Performance Standards (2012)<br>Annex D: Project Screening Procedure<br>Annex E: Project Screening Checklists<br>Annex F: Annual Reporting Forms<br>Annex G: MCA-Nepal Grievance / Complaint Resolution Procedure<br>Annex H: Contacts and Communications list (at MCA, MCC, and with Project/investment Proponents)<br>Annex I: TORs for the ESP staff |

## 8.2 Environment and Social Management Plan

### 8.2.1 Contents

An Environmental and Social Management Plan (ESMP) has been developed for the potential compact projects, and is bound separately. The ESMP includes the following sections:

- Introduction
- Objectives of the ESMP
- Summary of Environmental and Social Impacts
- Mitigation Measures
- Environmental and Social Monitoring Plan
- Institutional Arrangements
- Implementation Schedule
- Recommended Special Contract Clauses for Environmental and Social Protection During Construction

The ESMP will become an integral part of the construction contracts (see Annex G).

### 8.2.2 Costs

The environmental and social costs for the project fall into two categories:

- Costs for the implementation of the ESMP including environmental mitigation costs (not including land acquisition)
- Benefit-sharing Costs.

**ESMP Implementation Costs**
ESMP implementation costs include costs associated directly with the physical mitigation of project environmental and social impacts and the costs associated with the administration and management of the environmental and social programs associated with project implementation.

***Environmental Mitigation and Monitoring Costs.*** Total environmental and social mitigation costs are difficult to estimate at this early development stage with a high degree of accuracy and will probably not be known until the preliminary design of the project is complete. Costs have been estimated on the basis of best available information as of this writing.

***ESMP Administration/Management Costs.*** Administration and management costs of implementation of the ESMP are inclusive of monitoring and evaluation, oversight supervision, institutional strengthening, training and capacity building, technical assistance to OMCN's environmental unit and undefined impacts such as special provisions for chance find processing.

The cost of implementing the ESMP is shown in Table 94. These estimates will be reviewed and revised during the development of the full ESIA.

Table 94. ESMP and ESMS Implementation Costs

| ESMP Component | COST, USD |
|---|---|
| **Design and Implementation of Physical Mitigation Measures** | |
| Contractor – built into contract | see estimates in Annex K (included in construction cost) |
| **Administration and Management of Mitigation Program Implementation** | |
| *Supervision – Environment* (to be built into the contract for Engineering Supervision cost) | 10-20% of total supervision cost |
| *Environmental sampling and analysis* (separate estimate for environmental quality monitoring - air, water, noise, soils) | $100,000 |
| *Independent Environmental Performance Monitoring* (may be included in supervision engineer TOR) | $250,000 (5 years) |
| *Institutional Strengthening, Training and Capacity Building* | $150,000 |
| § Formation of MCA-Nepal environmental unit | |
| § Local authorities, communities and other stakeholders | |
| § On-site training | |
| § Offsite training | |
| § Local capacity building | |
| § Equipment and logistics | |
| *Technical Assistance to OMCN environmental unit* | $250,000 (over 5 years) |
| § Provision of outside consultants | |
| § Manual of functions and procedures | |
| § Assist in development of environmental database | |
| § Special issues – e.g. water quality, erosion, birds | |
| § ESMP protocols and procedures | |
| § Assist in development of MCA-N Environmental Unit | |
| § Assist in implementation of updated management plans | |
| § Contractor liaison | |
| § TORs | |
| *Support to MCA-N in Stakeholder Engagement* | $100,000 |
| **Total Administrative/Management Cost of ESMP Implementation excluding cost of physical mitigation measure captured in Contractors total cost** | **$850,000** |

**Benefit-sharing Costs**

Benefit-sharing can take many forms as has been shown by the World Bank[210] and others[211].Most often benefit sharing programs are features of hydropower projects where there is a reasonably

[210] Wang, 2012. "Social Development Working Papers - Paper No. 128 - A Guide for Local Benefit Sharing in Hydropower Projects" by Chaogang Wang, World Bank, June 2012

well-defined projection of revenues that can be shared. In those cases, benefit-sharing programs have ranged from 1 to 9% of annual gross sales or revenues. In the case of the MCC transmission lines, the funding mechanism for benefit-sharing can be described as a "system benefit charge" that is applied to the predicted financial annual capital recovery amounts for the projects. As of this writing, benefit sharing is estimated as 3.8% of the total capital cost of the program. Annex K has details on how this was calculated, including assumptions. However, benefit sharing budgets should be identified after negotiations between MCC and GoN and with input from stakeholders.

**Total Environmental Costs**

Table 95 estimates of the environmental costs associated with the project. This table is for illustrative purposes only and will very likely change as the design effort proceeds and decisions are made about which of the lines will remain as part of the compact projects.

[211] Égré 2010. "Revised Final Report - Benefit Sharing Issue" United Nations Environment Programme -Dams and Development Project - Compendium on Relevant Practices - 2nd Stage, Prepared by: Mr. Dominique ÉGRÉ Dominique Égré Consultants Inc. Montreal (Quebec) Canada, February 10th, 2007.

Table 95. Environmental Mitigation and Benefit-Sharing Costs

| Line ID: | Total Construction Cost (million USD) | Environmental Mitigation and Monitoring Cost (million USD) | Annual Benefit Sharing Cost Allowance (million USD) | Total Benefit Sharing Cost over the Compact (million USD) |
|---|---|---|---|---|
| NR1 | $385.61 | $6.92 | $2.17 | $8.21 |
| XB1 | $9.78 | $0.69 | $0.18 | $0.69 |
| NR3 | $15.78 | $1.99 | $0.90 | $3.40 |
| NR4 | $4.01 | $1.46 | $1.03 | $3.91 |
| T2' | $25.29 | $1.12 | $0.28 | $1.06 |
| T3 | $37.97 | $1.73 | $0.29 | $1.09 |
| T8 | $38.70 | $0.89 | $0.37 | $1.41 |
| ***Total*** | ***$517.15*** | ***$14.82*** | ***$5.22*** | ***$19.77*** |

Note: Total Construction Cost is defined as the total technical cost plus contingency, not including resettlement or MCC / MCA-N management costs

| | |
|---|---|
| **Estimated Cost of the four (4) ESIAs for the four (4) packages** (million USD) | $4.07 |

**Assumptions (Please see Annex K for more detailed list of assumptions)**

| | |
|---|---|
| Total 5-year ESMP and ESMS Implementation Cost (This is a management cost accruing to MCA-N that covers all lines; not included in the Mitigation / Monitoring Costs above which will be part of the Construction Contracts) (million USD) | $0.85 |
| Total Construction Cost Percent Needed for Environmental Mitigation and Monitoring | 2.86% |
| Total Construction Cost Percent Recommended for Benefit Sharing | 3.82% |

# 9. ESIA Terms of Reference and Cost Estimates

Annex L contains a detailed Draft Terms of Reference (TOR) designed to guide the development of an Environmental and Social Impact Assessment (ESIA) and Environmental and Social Management Plan (ESMP) on priority transmission lines projects that have been proposed by the Government of Nepal to be included for funding in a possible Grant Agreement with the Millennium Challenge Corporation (MCC).

This PESIA assumes that the Compact projects will be divided into four packages, to be carried out by up to four contractors. There will be one ESIA per package, for a total of four. It is estimated that a full ESIA for a package including permits will cost approximately US$1.02 million and will take up to 18 months to complete. Please see details of the ESIA cost estimates in Annex K, and sope of work in Annex L.

This indicates a total cost for ESIA development of approximately US$4.0 million. Given sufficient information regarding the Preliminary Design and a robust stakeholder Engagement Plan, the completion of the RAP at least 3 or 4 months prior to the completion of the ESIA, the ESIAs and updated ESMPs should be completed during the CIF period, assumed to be two years.


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