Managing Environmental and Social Impacts of Hydropower in Bhutan

Final Report

June 15, 2016

Prepared in Collaboration between the
Royal Government of Bhutan and the World Bank

WORLD BANK GROUP

ASTAE
Asia Sustainable and Alternative Energy Program

SAWI SOUTH ASIA WATER INITIATIVE

1818 H Street NW
Washington, DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org
www.worldbank.org/hydro
Twitter: @WBG_Energy
Email: feedback@worldbank.org

Cover Photos: Rikard Liden and Kimberly Lyon, World Bank.

Contents

List of Boxes

List of Figures

List of Tables

Acknowledgments

This report is the output of Economic and Sector Work (ESW) requested by the Royal Government of Bhutan, under the leadership of the Ministry of Economic Affairs (MoEA), the National Environment Commission (NEC) and the Gross National Happiness Commission (GNHC). Special gratitude is extended to the following officials:

- From the MoEA: Dasho Yeshi Wangdi (Secretary); Sonam P Wangdi (Director General, Department of Hydropower and Power Systems or DHPS); Karma P Dorji (Chief Engineer, DHPS); Karma Tshewang (Chief Engineer, DHPS); Tashi Pem (Executive Engineer, DHPS); Sonam Tshering (Deputy Executive Engineer, DHPS); Sonam Dorji (Engineer, DHPS); Deshen Wangmo (GIS Specialist, DHPS); and Wangmo Wangmo (GIS Specialist, DHPS).
- From the NEC Secretariat (NECS): Dasho Ugyen Tshewang (Secretary); Tenzin Khorlo (Chief Environment Officer); Tenzin Wangmo (Chief Environment Officer); and Tshering Dorji (Sr. Environment Officer).
- From the GNHC: Dasho Sonam Wangchuk (Secretary) and Wangchuk Namgay (Chief Program Officer).

The team is especially grateful to the focal points for the study: Kinley Tenzin (Engineer, DHPS); Passang Dorji (Program Coordinator, GNHC); and Tshering Dendup (Assistant Environmental Officer, NECS).

Contributions to the study were also provided by Druk Green Power Corporation, the Ministry of Home and Cultural Affairs, the Department of Hydro-Met Services, the Department of Renewable Energy, the Tourism Council of Bhutan, the Ministry of Agriculture and Forests, the National Land Commission, the Bhutan Trust Fund for Environmental Conservation, and WWF Bhutan.

We would also like to acknowledge the Mangdechhu Hydroelectric Project Authority, under the leadership of A.K. Mishra (Managing Director) and Chencho Tshering (Joint Managing Director), for its support to the Hydropower Sustainability Assessment for Mangdechhu Hydroelectric Project (MHEP), which provided valuable insights to this work. We thank the team of accredited assessors: Dr. Helen Locher (lead); Dr. Bernt Rydgren; Dr. Jörg Hartmann; and Margaret Trias, who carried out the official assessment.

This study was conducted by a World Bank team involving four Global Practices: Energy & Extractives; Water; Environment & Natural Resources; and Social, Urban, Rural & Resilience. The team was led by Rikard Liden (Sr. Hydropower Specialist); Rohit Mittal (Sr. Energy Specialist); and Urvashi Narain (Sr. Environmental Economist), with contributions from Pyush Dogra (Sr. Environmental Specialist); Jun Zeng (Sr. Social Development Specialist); Kimberly Lyon (Water Resources Management Analyst); Stefania Abakerli (Sr. Social Development Specialist); Juan

Quintero (Consultant); Bandita Sijapati (Consultant); Vaideeswaran Sankaran (Consultant); and Alice Lin (Consultant).

The team thanks Julia Bucknall (Practice Manager, South Asia Energy); Jie Tang (Program Leader—Bangladesh, Bhutan, Nepal); and Genevieve Boyreau (Resident Representative, Bhutan/ Sr. Economist) for their overall guidance and support. Constructive feedback was provided by the study's peer reviewers: William Rex (Global Lead, Hydropower and Dams); Glenn Morgan (Advisor, OPSOR); Chaogang Wang (Sr. Social Development Specialist); Nicolas Sans (Hydropower Specialist); and Sanjay Srivastava (Lead Environmental Specialist). The team also thanks the entire Bhutan Country Office for their support in the course of this work.

The Royal Government of Bhutan and the World Bank gratefully acknowledge the financial support provided for this activity by the South Asia Water Initiative (SAWI) and The Asia Sustainable and Alternative Energy Program (ASTAE).

The opinions expressed in this report and any errors therein are the sole responsibility of the authors and should not be attributed to the individuals or institutions acknowledged above.

Executive Summary

Background and objective

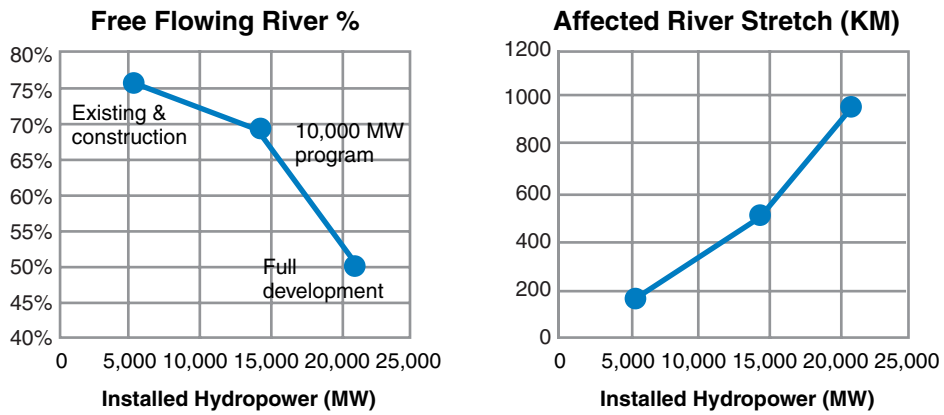
Development of Bhutan's untapped hydropower resources has the potential to spur economic growth, rapidly increase export revenue, reduce poverty, and bring about sustained improvements in human development. The Royal Government of Bhutan (RGoB) has, therefore, embarked on an ambitious plan to develop the renewable hydropower resources in the country. Large hydropower plants generating 1,606 MW are already operational, and new plants with an additional capacity of 3,658 MW are under construction and expected to be commissioned by 2018/19. Agreements have been reached on projects involving total additional capacity of 1,520 MW, for which construction is expected to start in 2016/17. Furthermore, projects with a total additional capacity of 7,412 MW are currently being discussed with potential developers. According to these plans, the RGoB will commission close to 12,600 MW of new hydropower by the end of the next decade, becoming by far the highest hydropower producer per capita in the world.

With its strong emphasis on preserving the natural and cultural values of Bhutan, the government has expressed concern over the country's capacity to address the socioenvironmental impacts of the rapid hydropower scale-up that it seeks to undertake. At the request of the RGoB, this study was initiated to provide guidance on how to address the potential environmental and social (E&S) impacts of the currently planned hydropower projects as well as the policy framework and institutional capacity needed to successfully manage those impacts. The World Bank, in close collaboration with the Department of Hydropower and Power Systems (DHPS), the National Environmental Commission (NEC), and the Gross National Happiness Commission (GNHC), has conducted the study. The findings of this study are framed in the Bhutanese context and focus on recommendations that are relevant for Bhutan.

Main results and conclusions

The study has found that the main impacts of hydropower development in Bhutan relate to aquatic biodiversity and are cumulative, meaning that they are not of immediate concern but should get priority attention once the development of hydropower accelerates. In the long term, the potential negative impacts on aquatic biodiversity probably pose the biggest risk for hydropower development in the country. The geographical analysis conducted in this study indicates more rapid impacts on river connectivity after the 10,000 MW program has been completed, but a lack of data prevents a full understanding of how the cumulative impacts will increase, and how efficient the mitigation measures will be once hydropower development goes beyond the short-term horizon. In addition, as with all large infrastructure projects, this study has shown that there will be significant temporary impacts during construction, which, considering the very rapid and large expansion of hydropower with many projects planned to be undertaken in parallel, must be addressed in a countrywide and coordinated manner.

On the other hand, the development of hydropower will yield significant economic benefits for Bhutan, spurring E&S benefits,



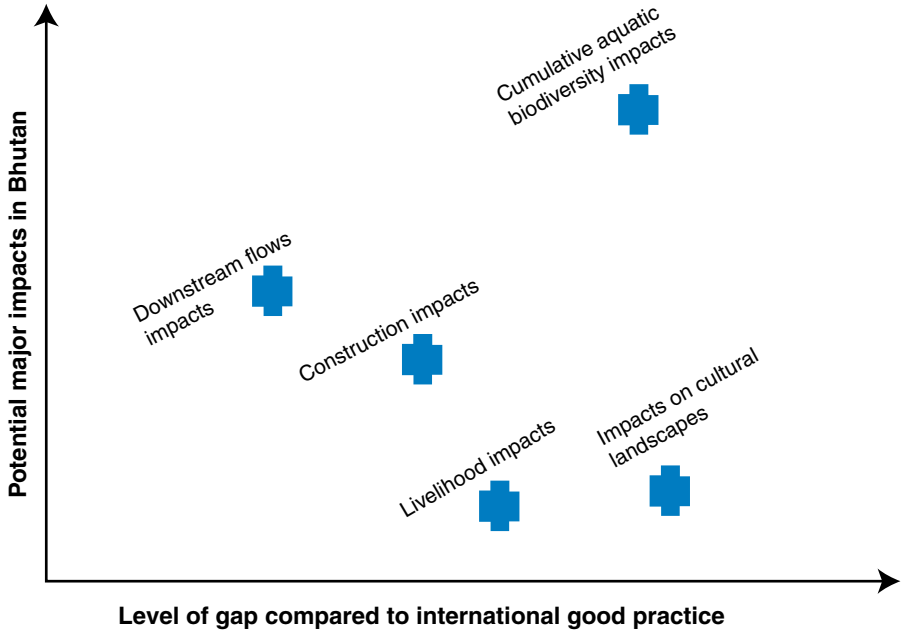
Cumulative impacts on river connectivity seem to be slightly synergistic, meaning they may increase in an accelerated manner as more hydropower capacity is installed. The 10,000 MW Program refers to projects that are under construction or have been agreed with potential developers. The full development includes all hydropower projects for which at least prefeasibility or reconnaissance studies are available.

if developed in a sustainable manner and if the revenues are well managed. Bhutan has geographic and demographic characteristics that are favorable to hydropower development. Most of the planned projects are run-of-river projects that have small footprints on terrestrial areas. Only seven planned potential projects are storage projects and, even in those cases, the steep valleys of Bhutan make the areal extension of the inundated areas relatively small. Furthermore, the stronger the institutional capacity of Bhutan to mitigate negative impacts and to distribute and communicate benefits, the more hydropower can be developed.

This study has identified a number of gaps in the management of E&S impacts and ranked them according to relevance for Bhutan. There is good awareness of E&S management issues for hydropower, but more attention has been given to capacity development related to technical aspects rather than E&S aspects: human and financial resources are not being channeled toward the E&S aspects to the same extent that they are being channeled toward technical capacity development, especially within the government institutions. This has resulted in a lack of manpower, resources, and skills among regulatory agencies and key stakeholders. Moreover, it has led to uncoordinated processes for the clearance of Environmental Impact Assessments (EIAs) and Environment Management Plans (EMPs), and for compliance monitoring.

Because of the lack of institutional capacity, gaps exist in the present management of the *environmental* impacts of hydropower development compared with international good practice:

- Early planning on a national scale, including strategic assessments of impacts and mitigation measures, has not been done since 2004 and has not considered cumulative impacts;
- Lack of guidelines for key areas, such as assessment of downstream flows and a code of practice on environmental management for contractors;
- Lack of baseline studies to inform the EIA and EMP, especially with data on aquatic biodiversity;
- Weaknesses in the implementation of EIAs and in the compliance with EMPs, resulting



Identified potential impacts that are not being fully addressed, compared with international good practice.

from inadequate quality assurance and monitoring.

This study has also identified a number of gaps in managing the *social* impacts of hydropower. There is a need to update the compensation rates for land acquisition (which have not been revised since 2009), and to strengthen the EIA process on social aspects, including the guidelines to fully assess the impacts of hydropower development on livelihoods. In addition, the impacts on cultural assets and landscapes are often not assessed. While these gaps may not be directly responsible for major impacts, given the country's favorable geography and associated small terrestrial footprints of hydropower projects, they do indicate a pattern of insufficient implementation/enforcement of the regulatory framework and prevent Bhutan's management of the social impacts of hydropower from fully meeting international good practice.

If hydropower development proceeds too quickly in Bhutan, with a narrow focus on improving technical capacity in parallel, public criticism could increase because of E&S management concerns. Failure to meet the rapidly increasing development of hydropower with a corresponding increase in capacity to manage the E&S impacts will lead to more management gaps, and thus, the risk of more negative impacts. On the other hand, capacity building in E&S management could also help reduce delays in the development of the country's hydropower—entailing cost savings and earlier revenue streams that would probably outweigh, by far, the cost of the capacity building.

In conclusion, despite due awareness and a good regulatory framework for managing the E&S impacts of hydropower in Bhutan, challenges remain in the upstream planning and in the implementation of the assessment and mitigation of impacts, mainly because of the lack of capacity among key government institutions to ensure quality and enforce good practices. Addressing the capacity constraints, and providing key institutions with the tools, structures, and

skills necessary for proper E&S management of hydropower would benefit the sustainability of Bhutan's natural and cultural values, as well as its hydropower and economic development.

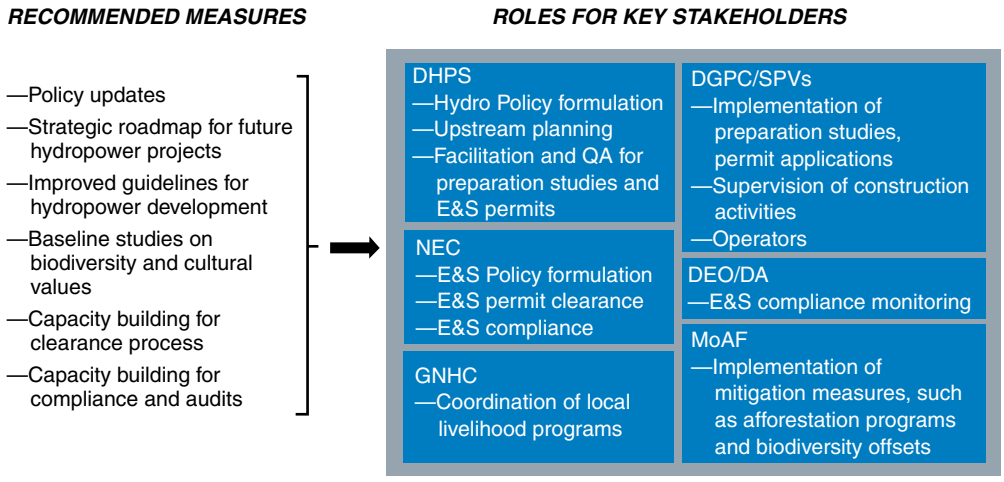
Recommendations

Recommendations to improve management of the E&S impacts of hydropower have been guided by the management gaps identified and the relevance of the potential impacts that the gaps are associated with in the Bhutanese context. The recommendations not only focus on filling the gaps, but also on improving the efficiency of E&S impact management. The recommendations below are listed in random order and complement each other.

Develop a strategic roadmap for the untapped hydropower development in Bhutan through a consultative process. The output should be a realistic action plan for implementation of hydropower projects, based on the country's macroeconomic and socio-environmental absorptive capacity. The main gap addressed with this activity is the lack of assessment and mitigation of the cumulative impacts on aquatic biodiversity. The main subactivities to develop the strategic roadmap are:

- Update the 2004 Hydropower Master Plan, focusing on critically revising technical solutions and cost estimates for future hydropower sites;
- Conduct a financial and market study focused on national and export demand forecasts for electricity;
- Conduct countrywide, basin-level E&S studies focused on cumulative impacts;
- Conduct an optimization study to balance the trade-offs at the national level between hydropower development, impacts on natural and cultural values, and economic development.

Develop sustainability guidelines for preparation, construction, and operation of hydropower infrastructure. The output should



The recommendations for improved management of the E&S impacts of hydropower are directed toward the specific roles of the key stakeholders involved in the country's hydropower development: DHPS (Department of Hydropower and Power Systems), NEC (National Environment Commission), GNHC (Gross National Happiness Commission), DGPC/SPVs (Druk Green Power Corporation/Special Purpose Vehicles), DEOs/DA (Dzongkhag Environmental Officers/Dzongkhag Administration), and MoAF (Ministry of Agriculture of Forests).

be a comprehensive set of national guidelines, which will help mainstream and ensure the use of uniform practices for hydropower development across Bhutan. These guidelines should address the identified lack of assessment and mitigation of the cumulative impacts on aquatic biodiversity, as well as the current gaps in EIA guidelines and weaknesses in EIA/EMP implementation (e.g., the impacts on downstream flows, livelihoods, and cultural landscapes from hydropower development in general, and the specific impacts associated with construction work). The key gaps in managing the impacts of hydropower most relevant to Bhutan that should be specifically addressed in the new guidelines are:

- *Cumulative impacts on aquatic biodiversity:* The guidelines should specify how individual projects should assess the likely impacts on aquatic biodiversity and how they should monitor the impacts and effectiveness of mitigation measures;
- *Impacts on downstream flows:* The guidelines should specify how individual projects should determine appropriate downstream flow releases, as well as what individual projects should do to enable monitoring of their compliance with those guidelines;
- *Code of Practice* (Environmental Specifications): The guidelines should propose environmental specifications for management during construction, which should be included in the contracts for the main contractors of hydropower projects;
- *Cumulative impacts:* The guidelines should clarify how individual projects should assess the cumulative impacts in general.

In addition, the guidelines will provide an opportunity to agree on the appropriate extent of requirements for other gaps in management, even though the associated impacts are relatively modest on a national scale. Among these missing elements are the impacts on cultural heritage and landscapes; the impacts on livelihoods (as measured through Social Impact Assessments); grievance redressal mechanisms (GRMs); community development; and communication and disclosure of documents. Essential to the new sustainability guidelines are clear roles and responsibilities for the E&S management of hydropower.

Build capacity to improve the clearance process for environmental permits for hydropower development, focusing on regulatory agencies and key stakeholders. Adequate and timely preparation will allow for the early identification of E&S impacts and for appropriate mitigation measures to be proposed. A predictable regulatory process will save project managers time in the preparation of hydropower projects and provide developers with more reliable time estimates. This activity should mainly address the identified gaps in EIA guidelines and weaknesses in EIA/EMP implementation. It should focus on the following three subactivities:

- *Improving NEC's regulatory role:* Improving the organization of NEC, focusing on the need to separate regulatory duties from the responsibility for conducting studies; the need for hydropower-specific subdepartments or staff; and the need to bring in more social development expertise. In addition, a comprehensive staff training and skills enhancement program should be introduced, focused on evaluating preparatory studies for hydropower;
- *Improving the DHPS's facilitation and preparation roles:* Improving the DHPS organization, focusing on the two specific roles of the DHPS in the clearance process: as a quality assurance official and as a facilitator of the process. A comprehensive training program for DHPS staff should be implemented, covering all aspects of sustainable hydropower development as well as procurement and supervision of large

consultancies for the preparation of Detailed Project Reports (DPRs) and E&S Impact Assessments (ESIAs);

- *Improving coordination and streamlining the clearance process:* Improving coordination of hydropower planning and preparation, and streamlining the E&S clearance process for new projects. One possible solution for the lack of coordination is to form a cross-sectoral committee that meets regularly to create a general understanding of the hydropower process and allow cross-sectoral issues and opportunities to be discussed.

It is recommended that training and skills enhancement be based on the Hydropower Sustainability Assessment Protocol, which provides a balanced set of topics for hydropower planning and development. The Protocol should be used as a framework for the training program, which can be supplemented with topics that are especially important in the Bhutanese context.

Conduct targeted baseline studies to fill in data gaps and build up national references for key parameters relevant to hydropower. The outputs should be countrywide inventories and analyses, which impact assessments can use to identify local impacts and determine their relevance. This activity should mainly address the identified gaps in assessment of the cumulative impacts on aquatic biodiversity and cultural landscape. The following two comprehensive activities should be prioritized:

- *Mapping of aquatic biodiversity:* Creating a common, georeferenced database drawing on existing work (fish assessments have been carried out by the WWF and NCA), followed by a targeted measurement campaign to fill in the most crucial gaps.
- *Mapping of cultural values and landscapes:* Finalizing the preliminary, interactive cultural map of Bhutan, prepared by the Ministry of Home and Cultural Affairs (MoHCA), followed by further data collection by cultural mapping experts in a variety of formats—graphs, aerial photographs, satellite-produced images, statistical databases, etc.

The level of detail of the baseline studies should take into account the amount of resources available. The geographical focus of measurement campaigns should be informed by the locations of hydropower development in the near-term pipeline and should, initially, prioritize reconnaissance over detail, to get an overview.

Develop capacity for improving compliance and conduct independent monitoring. The outputs should be improved EMP implementation and objective documentation of the impacts, both positive and negative, of hydropower development in Bhutan. The main subactivities to be undertaken are:

- *Improving the day-to-day supervision by Dzongkhag Environmental Officers (DEOs) and NEC:* Improving the relevant procedures for NEC and DEOs, focusing on the reporting mechanisms and streamlining the compliance monitoring process.
- *Developing guidelines for independent surveys:* Developing guidelines and templates for at least three major impact evaluations—before construction starts, during construction, and after commissioning of the project. These surveys, which should be the responsibility of the developers, should focus on the indirect impacts (e.g., livelihood parameters for the affected people and biodiversity parameters).
- *Creating capacity in the DHPS/Druk Green Power Corporation (DGPC) to carry out internal audits using the new sustainability guidelines:* The new guidelines should be used as the basis for developing internal audit procedures for E&S aspects. It is important

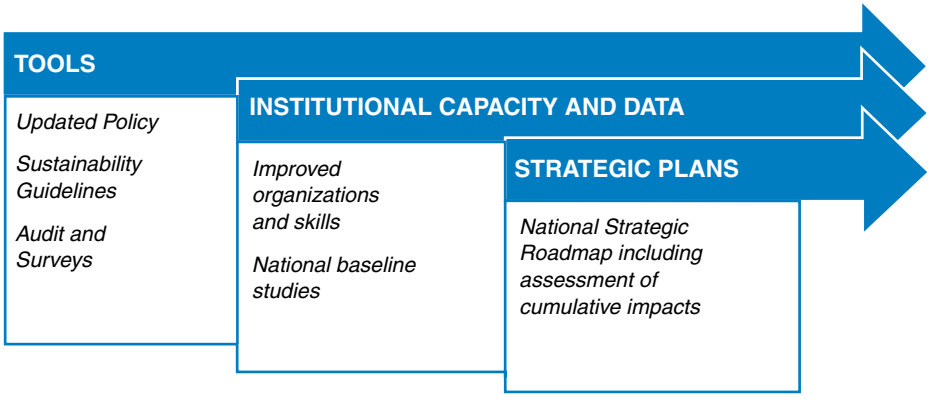
to build this audit capacity within the DHPS and DGPC because they are directly involved in hydropower projects under all development models in Bhutan.

- *Making extended use of an international Panel of Experts (PoE):* The use of a PoE should become standard practice in the country's new hydropower projects. The primary function of the PoE is not to check compliance but to advise the developer on improved methods to address the often complex and case-specific challenges of hydropower projects.

Update the Bhutan Hydropower Policy and the inputs to other relevant sector policies. The DHPS is currently updating the Hydropower Policy. The new policy will define the overall direction for the recommended strategic roadmap and sustainability guidelines, and address them in turn. Furthermore, the DHPS should work as an active stakeholder to influence policies that other ministries are responsible for, most importantly regarding the compensation levels for land acquisitions.

Fully implementing the above recommendations will not be easy and require many resources and a strong commitment on the part of the key stakeholders involved in Bhutan's hydropower development. It is therefore wise to be practical: start with the low-hanging fruits, and aim for a stepwise, gradual increase in capacity to manage the E&S impacts of hydropower. Developing the necessary tools, such as guidelines and procedures for internal audits, can be done relatively quickly and will automatically foster capacity building of the institutions involved. As resources become available, a broader program to build institutional capacity and national databases should be developed, to enable more strategic plans to be formulated for the future development of hydropower in the country.

The responsibility for implementing the recommended measures to improve the E&S management of hydropower lies mainly with government institutions: the DHPS, as a facilitator for planning and preparation of hydropower projects, and NEC, as the regulator for all stages of hydropower development. However, collaboration with other key stakeholders such as DGPC, GNHC, DEOs/*Dzongkhag* administration, the Ministry of Agriculture and Forests (MoAF), the Tourism Council of Bhutan (TCB), and MoHCA is crucial. These stakeholders can provide sector knowledge and contribute to the consultative approach, thereby ensuring broad ownership of the tools and strategic plans.



It is recommended that activities be implemented to improve the E&S management of hydropower in a stepwise manner—first creating tools for better management, next building institutional capacity and data, and finally consolidating knowledge and information into strategic plans.

Acronyms and Abbreviations

ADB	Asian Development Bank
BEA	Bhutan Electricity Authority
BHPCL	Basochhu Hydro Power Corporation Limited
BPC	Bhutan Power Corporation
BWP	Bhutan Water Partnership
CAT	Catchment Area Treatment
CDM	Clean Development Mechanism
CEA	Cumulative Environmental Assessment
CO_2e	Carbon Dioxide Equivalent
CPSU	Central Public Sector Undertaking
CSR	Corporate Social Responsibility
DA	*Dzongkhag* Administration
DEO	*Dzongkhag* Environmental Officer
DFPS	Department of Forests and Park Services
DGPC	Druk Green Power Corporation
DHI	Druk Holding and Investments
DHMS	Department of Hydro-Met Services
DHPS	Department of Hydropower and Power Systems
DPR	Detailed Project Report
DRE	Department of Renewable Energy
E&S	Environmental and Social
EA	Environmental Assessment
EAAB	Environmental Assessment Advisory Board
e-flows	Environmental Flows
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ESIA	Environmental and Social Impact Assessment
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GLOF	Glacial Lake Outburst Flood
GNH	Gross National Happiness
GNHC	Gross National Happiness Commission
GoI	Government of India
GRM	Grievance Redressal Mechanism
HEP	Hydroelectric Project
IG	Inter-Governmental
IWRM	Integrated Water Resources Management
JV	Joint Venture

kWh	Kilo Watt Hour
MCA	Multi-Criteria Analysis
MHEP	Mangdechhu Hydroelectric Project
MHPA	Mangdechhu Hydroelectric Project Authority
MoAF	Ministry of Agriculture and Forests
MoEA	Ministry of Economic Affairs
MoF	Ministry of Finance
MoHCA	Ministry of Home and Cultural Affairs
MoLHR	Ministry of Labour and Human Resources
MoWHS	Ministry of Works and Human Settlement
Msl	Mean Sea Level
MW	Mega Watt
NEC	National Environment Commission
NECS	National Environment Commission Secretariat
NHPC	National Hydroelectric Power Corporation (India)
NHPP	Nikachhu Hydropower Project
NLC	National Land Commission
NOC	No Objection Certificate
NPPF	National Pension and Provident Fund
O&M	Operations and Maintenance
OCR	Ordinary Capital Resource
OD	Organizational Development
PoE	Panel of Experts
PPP	Public-Private Partnership
PSMP	Power Sector Master Plan
R&R	Resettlement and Rehabilitation
RAP	Resettlement Action Plan
RCSC	Royal Civil Services Commission
RE	Renewable Energy
RGoB	Royal Government of Bhutan
RoW	Right of Way
RSPN	Royal Society for the Protection of Nature
RZB	Raiffeisen Zentralbank Österreich AG
SBI	State Bank of India
SJVN	Satluj Jal Vidyut Nigam Ltd.
SPV	Special Purpose Vehicle
T&D	Transmission and Distribution
TCB	Tourism Council of Bhutan
THyE	Tangsibji Hydro Energy Limited
TOR	Terms of Reference
VEC	Valued Ecosystem Components
WWF	World Wildlife Fund (for Nature)

Chapter 1
Introduction

1.1 Background and objective

While Bhutan is predominantly an agriculture-based society (the agriculture sector employs more than 60 percent of the population), tourism and hydropower are the main drivers of the economy and principal sources of foreign exchange. The development of Bhutan's untapped hydropower resources has the potential to spur economic growth, rapidly increase export revenue, reduce poverty, and bring about sustained improvements in human development. Driven by investments in the hydropower sector, the country has grown at an average rate of 7 percent per year over the last decade while poverty has declined.

An acceleration of hydropower development, however, creates challenges such as how to maintain macroeconomic stability and how to ensure the expansion is environmentally and socially sustainable. Following deliberation by the *Lhengye Zhungtsog* (Council of Ministers) in its 60th session, held on December 30, 2014, on "Recommendation on way forward for 10,000 MW Hydropower Development," the Ministry of Economic Affairs (MoEA) was asked to prepare a realistic plan for implementation of hydropower projects based on the absorptive capacity of the national economy. This plan was to include undertaking a comprehensive study of the country's capacity to deal with the macroeconomic and socioenvironmental impacts of the hydropower projects planned for development in the medium to long term. Based on this plan, the Royal Government of Bhutan (RGoB) will be able to define a long-term strategy for the development of hydropower.

While a separate study on the macroeconomic impacts of the construction of hydropower infrastructure, at the request of RGoB, has already been completed,[1] this new study, "Managing Environmental and Social Impacts of Hydropower in Bhutan," aims to look at the following:

- Environmental and social (E&S) impacts of hydropower infrastructure planned under the 10,000 MW development initiative, and beyond;
- Measures necessary for mitigation/minimization of the adverse impacts of hydropower development as well as advice on the timing of those measures.

[1] Bhutan—Public Finance Reforms towards Economic Self-Reliance, World Bank, Final: November, 2015.

1.2 Methodology

This report summarizes the findings of a study carried out by the World Bank, with the support of key stakeholders from the RGoB, to assess the current and potential E&S impacts of hydropower in Bhutan, as well as the policy framework and institutional capacity needed to successfully manage those impacts. It follows a rapid assessment, carried out during the second half of 2015, to be able to give preliminary recommendations in time for the 16th Session of the National Council, held in November/December 2015. This final report is based on more extensive data gathering and analyses, and provides recommendations for the RGoB on the next steps to improve the sustainability of its hydropower development.

The study is based on the following components:

- A geographical analysis of key potential impacts of hydropower on the natural environment and communities. This analysis was done from the national perspective to provide estimates of potential impacts associated with four cumulative hydropower development scenarios: (1) existing projects; (2) projects under construction; (3) a revised 10,000 MW program; and (4) other potential sites that are still in the reconnaissance or prefeasibility phase.
- An institutional assessment, based on interviews with key stakeholders, notably the Department of Hydropower and Power Systems (DHPS), the National Environment Commission (NEC), the Gross National Happiness Commission (GNHC), and the Druk Green Power Corporation (DGPC). The assessment identifies both technical and capacity constraints and opportunities for simplification, role refinement, and training.
- An analysis of the existing policies, guidelines, and practices against international good practice and experience. This analysis was based on interviews, document reviews (including ESIAs), and site visits to hydropower projects, both operating and under construction.
- An assessment of one hydropower project (the 720 MW Mangdechhu Hydroelectric Project) by third-party accredited assessors, using the Hydropower Sustainability Assessment Protocol.

The study focused on E&S impacts, including occupational health and safety. Dam safety, which is part of the World Bank safeguards, was not considered.

The findings and recommendations of this final report were presented to a wide group of stakeholders at a meeting held in Thimphu, April 12–13, 2016 and were further refined based on stakeholder input. The team thanks the counterparts for their support and input over the course of this study.

Chapter 2
Geographic Context

Nestled in the eastern Himalayas, the Kingdom of Bhutan is a mountainous, landlocked country, situated between India and China. Its total area is approximately 38,394 km^2. Drained by the watershed of the Brahmaputra river basin, this small country (with a population of about 750,000) has considerable hydropower generation potential. From east to west, the main river systems are the Manas, Punatsangchhu/Sankosh, Wangchhu/Raidak, and the Amochhu/Torsa basins. Most rivers begin in Bhutan, while the Kurichhu, Gongri, and Amochhu headwaters are in Tibet. All rivers in Bhutan flow into India (Figure 2-1).

Bhutan is a mountainous country (Figure 2-2). Of the total land area, about 16,610 km^2 lies 3,000 meters above sea level. Altitudes vary from 100 meters above mean sea level (msl) in the southern subtropical region to 7,550 msl in the Northern alpine region. Glaciers cover about 900 km^2, and more than 2,500 glacial lakes have been identified. These glaciers and lakes provide an important buffer for sustained river flows during low rainfall years but also comprise potential hazards to hydraulic infrastructure through Glacial Lake Outburst Floods (GLOFs).

Over 72 percent of the land is under vegetation cover, and forests are an important natural resource for the country. The Constitution of Bhutan stipulates that the country maintain a "minimum of 60 percent of the total land under forest cover for all times to come." Broadleaf and mixed conifer forests are the major forest types. Almost 60 percent of the plant species found in the eastern Himalayan region are present in Bhutan. Bhutan has about 300 species of medicinal plants and about 46 species of rhododendrons.

A wide range of rare and endangered animals live in Bhutan's forests, and the country has been classified as one of the last biodiversity hotspots in the world. Some high-altitude species are the snow leopard and Bengal tiger, which are found at altitudes ranging from 3,000 to 4,000 meters; the red panda; gorals and langurs; the Himalayan black bear; sambars; wild pigs; the barking deer; the blue sheep; and the musk deer. Tropical forests species include the clouded leopard, the one-horned rhinoceros, elephants, water buffaloes, swamp deer, and the golden langur—a monkey species that is unique to Bhutan.

Figure 2-1 Major rivers of Bhutan

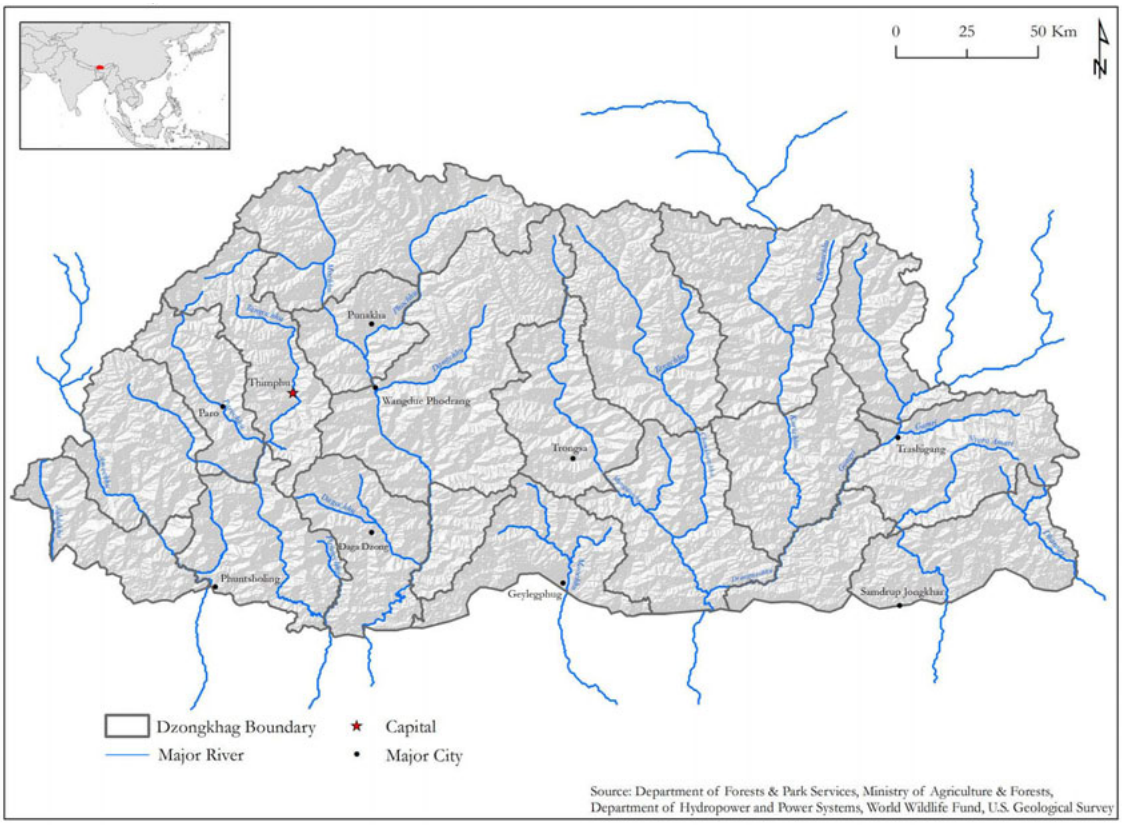
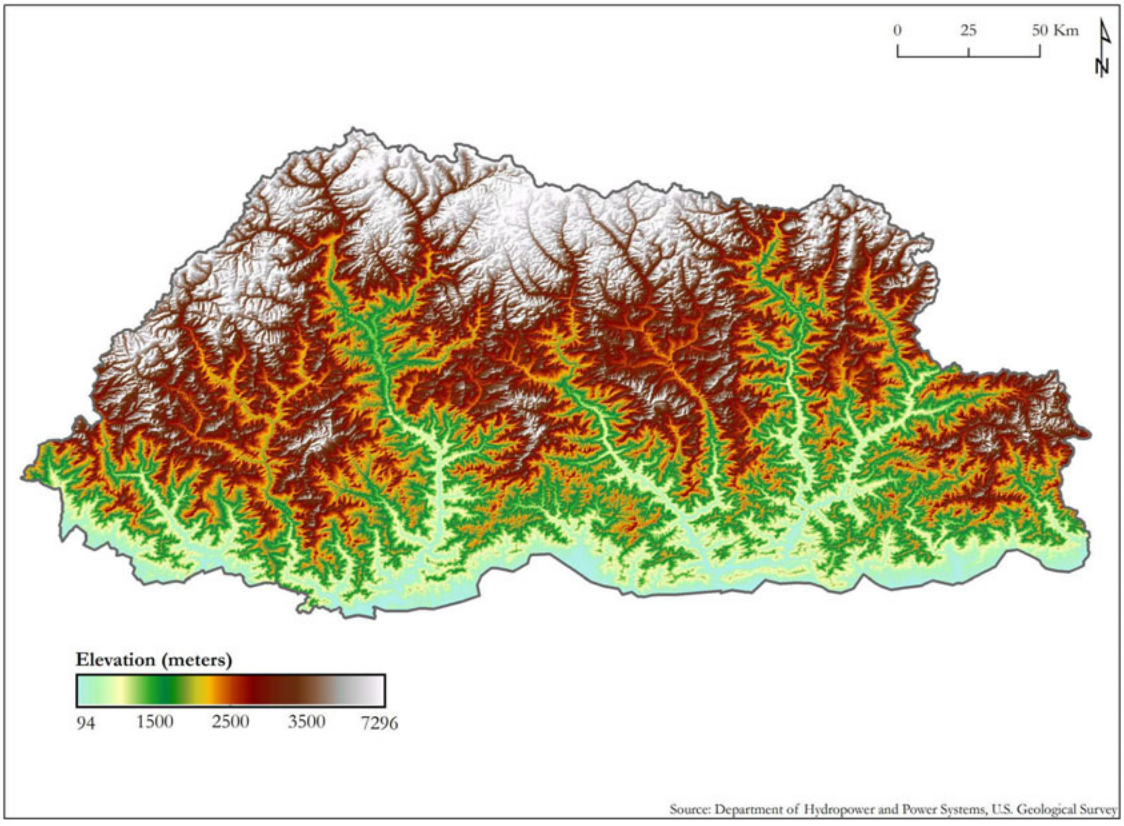


Figure 2-2 Topography of Bhutan

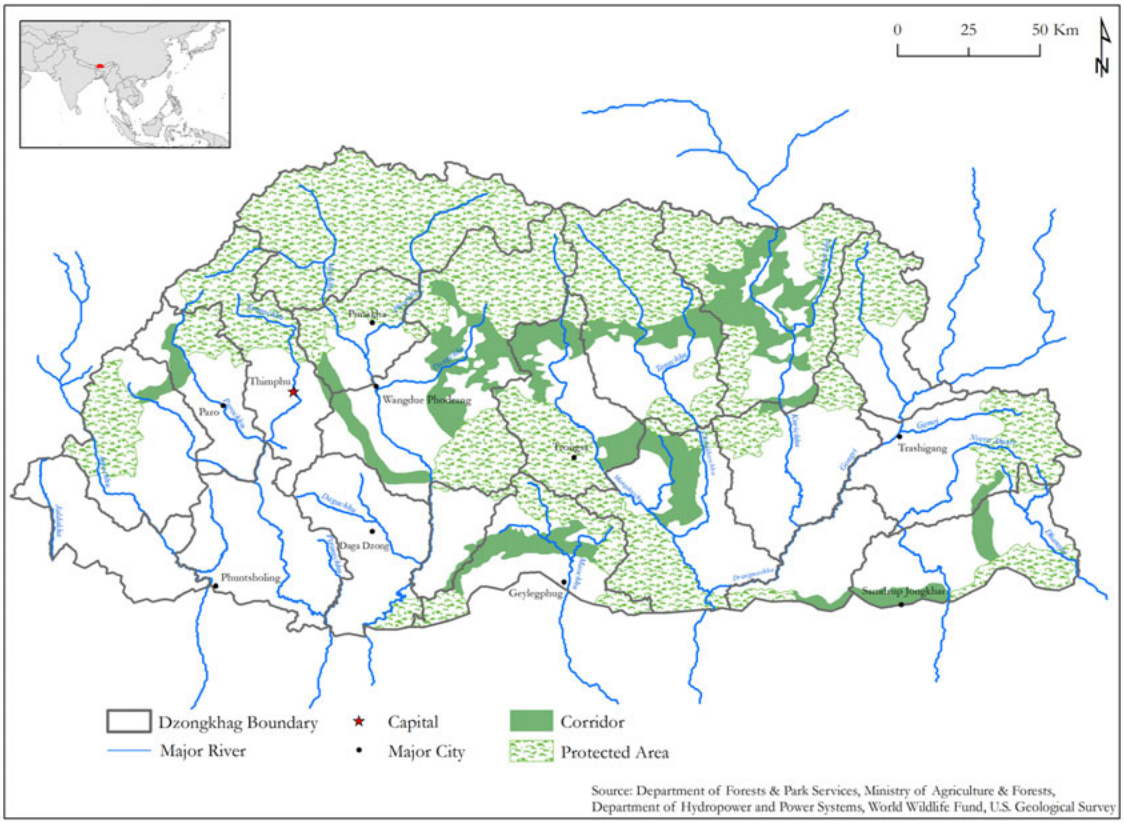


Bhutan also has a great variety of bird species and is recognized as the hub of 221 global endemic bird areas. The recorded number of bird species is over 670. Bhutan is also home to about 16 bird species that are endangered worldwide. These include the white-bellied heron, the Pallas's fish eagle and Blyth's kingfisher, to name a few. The Phobjikha valley in Wangdue Phodrang and Bomdeling in Trashi Yangtse are two especially important locations of the endangered black-necked cranes.

The government has designated nearly half of its land as protected area to help preserve the rich biodiversity in its flora and fauna (Figure 2-3).

The rivers and lakes of Bhutan have predominantly cold water and torrential stream fauna, except in the foothills and plains. The most recent study undertaken by the College of Natural Resources (CNR), Bhutan, and Saint Louis University, United States, suggests that the fish fauna comprise at least 93 fish species. It is expected that more species will be identified because the latest survey was conducted only during the monsoon season and excluded large areas of the country. Most species belong to the Cyprinid (carp) and Bagrid (catfish) families. The riverine ichthyofauna comprises one endemic species (the Khaling torrent catfish or Parachiloglanis bhutanensis) and one exotic species (the brown trout or Salmo trutta). The brown trout was first introduced in Bhutan in 1930 and established viable and self-replenishing stocks in a number of streams and rivers, including Haa, Thimphu, Paro, and some tributaries of the Sankosh and Manas rivers, that is, Mo, Ho, Mangdi, and Chamkhar. The stocking of brown trout was discontinued in 1983 because it was believed that brown trout was preying on, and competing with, the indigenous snow trout (*Schizothorax progastus*). The species list includes at least four threatened species, of which the Golden Mahseer (*Tor putitora*), is categorized as Endangered on the IUCN Red list. Tor putitora is also a totally protected species in the Forest and Nature Conservation Act of Bhutan (1995).

Figure 2-3 Protected areas of Bhutan



Chapter 3
Hydropower Development in Bhutan

3.1 Hydropower Development plans

The economy of Bhutan is significantly dependent on the development of its hydropower resources. With large energy demand in neighboring India, the strategy of the government is to develop its hydropower resources to earn export revenues in surplus of domestic needs. The RGoB, therefore, aims to develop hydropower projects in an accelerated manner to have installed capacity of at least 10,000 MW by 2020. The current plans show that this ambitious goal has resulted in significant acceleration of new hydropower construction, but the goal will not be fully met (Table 3-1). Projects with a total capacity of 1,606 MW[2] are already operational, and an additional 3,658 MW are under construction, and scheduled to be commissioned by 2018/19. Agreements have been reached on additional capacity of 1,520 MW; these projects are expected to start construction in 2016/17. Lastly, projects with a total capacity of 7,412 MW are currently under discussion with potential developers (Appendix A).

Assuming all of these planned projects will be commissioned by 2026, Bhutan will by then have added an average of 1,250 MW per year in the years to come, an impressive accomplishment as global development is around 30,000 MW per year. With more than 14,000 MW installed capacity by the year 2026, Bhutan will be by far the largest hydropower producer per capita in the world.

In the long term, the Power System Master Plan (PSMP), last updated in 2004, estimates the overall hydropower potential at 30,000 MW. To date, the RGoB has identified individual projects with a total projected installed capacity of more than 25,000 MW, of which some 21,000 MW have already been constructed, initiated, or studied in more detail (Figure 3-1). A subset of projects, the "10,000 MW Program," envisaged in the Economic Development Policy (2010) and the 11th Five-Year Plan (2013–18), includes those projects that are under construction as well as projects with Detailed Project Reports (DPRs) finalized, and agreed or under discussion with potential developers. The complete list of identified projects is presented in Appendix A.

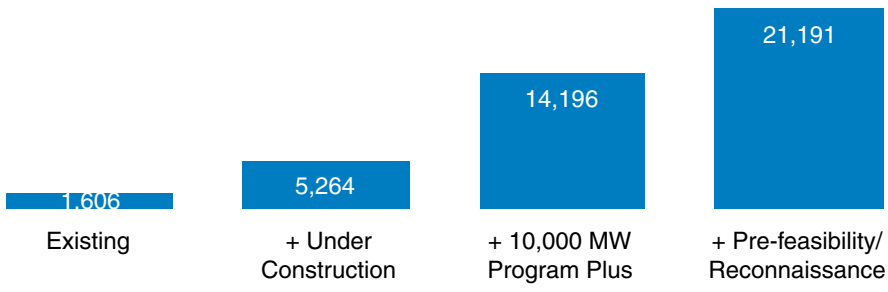
[2] Includes only large hydropower projects (>25 MW).

Table 3-1 Existing and pipeline hydropower projects in Bhutan

Project name	Construction start	Commissioning year	Capacity (MW)
Commissioned			
Tala	1997	2006/2007	1,020
Chukha	1974	1986/1988	336
Dagachhu	2009	2015	126
Basochhu	1997	2002/2005	64
Kurichhu	1995	2001/2002	60
Subtotal			**1,606**
Under construction			
Punatsangchhu I	2008	2019	1,200
Punatsangchhu II	2010	2018/2019	1,020
Mangdechhu	2010	2018	720
Nikachu	2014	2019	118
Kholongchhu	2015	2022	600
Subtotal			**3,658**
Near-term pipeline (agreed with India, April 2014)			
Bunakha	2016/2017	2022/2023	180
Chamkharchhu-I	2016	2025	770
Wangchhu	2016/2017	2024/2025	570
Subtotal			**1,520**

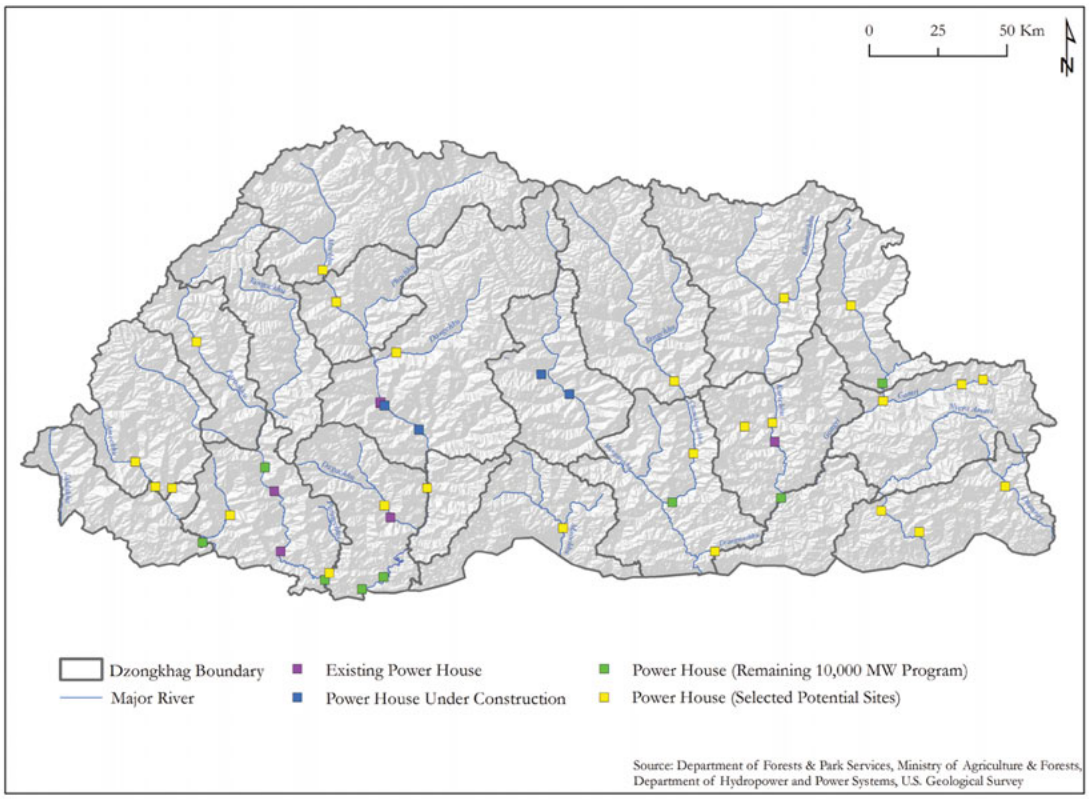
Source: Ministry of Economic Affairs, Department of Hydropower and Power Systems.

Figure 3-1 Cumulative development of hydropower in Bhutan[3]



[3] The 10,000 MW program is denoted with 'Plus' in all figures and tables to clarify that the program used in this study is slightly changed from its original set of projects based on information from DHPS. The program is still widely referred to as the 10,000 MW program. The projects included in the 10,000 MW Program Plus used for analyses in this study are detailed in Appendix 1.

Figure 3-2 **Identified project sites with studies in at least reconnaissance phase**



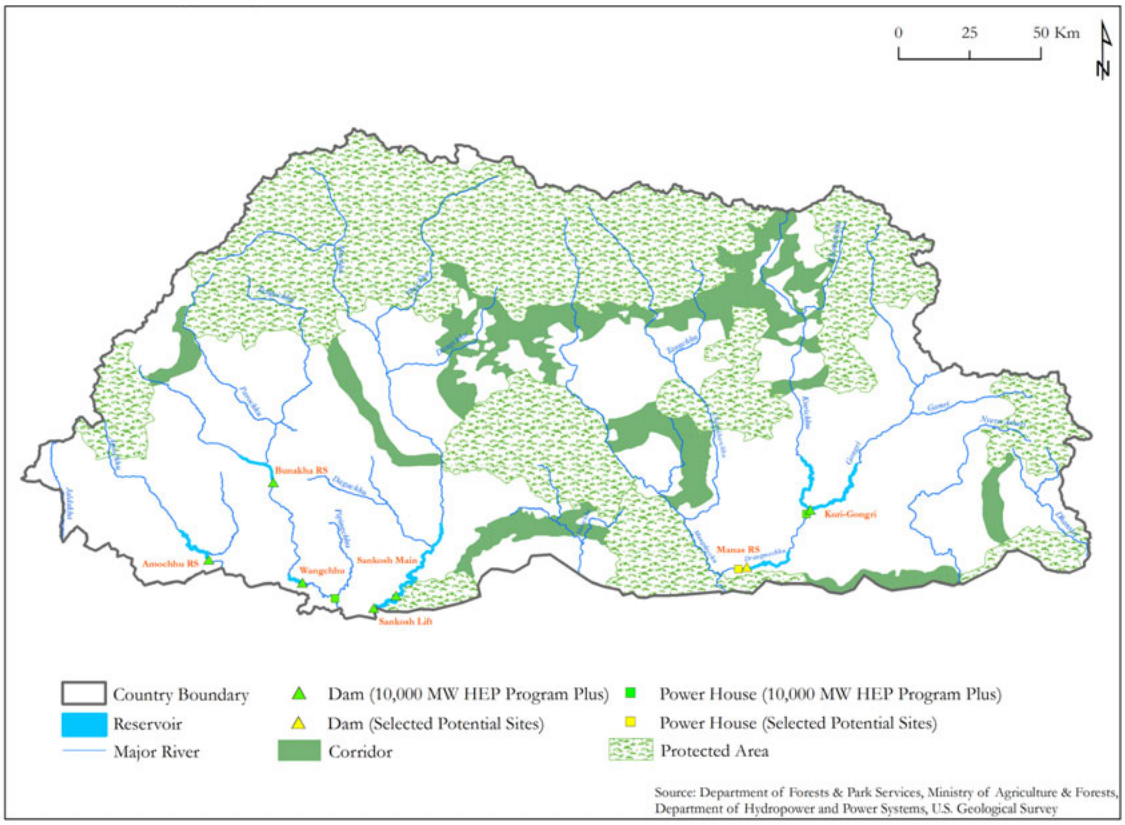
The hydropower sites together cover all the major river basins in Bhutan (Figure 3-2). The majority of sites, especially the projects under the 10,000 MW Program, are located in the southern part of the country while those under prefeasibility and reconnaissance studies (referred to as "Selected Potential Sites" in the maps) are spread across the country, including areas that lie more to the north.

Most of the planned projects in Bhutan are run-of-river projects. Only seven projects are envisaged as storage projects (Figure 3-3). Even when developed as storage projects (defined as having regulating capacity), the steep valleys of Bhutan make the areal extension of the inundated areas relatively small. The power density (= relation between installed capacity and inundated area) for all planned storage projects in Bhutan is higher than 20 W/m^2. By way of comparison, the Clean Development Mechanism (CDM) mechanism considers all projects with a power density above 4 W/m^2 eligible.

Hydropower projects in Bhutan are being implemented under three different models:

- The *Inter-Governmental (IG) model:* For the development of the country's hydropower resources, the RGoB has signed a strategic bilateral assistance cooperation agreement with the Government of India (GoI). Under this model, the GoI is responsible for mobilizing funding and implementing the project until the time of commissioning. The project's ownership is at that time transferred to the RGoB, with a certain amount of debt to be repaid to the GoI. The GoI buys all the electricity generated in surplus of domestic consumption, at a price determined on a cost-plus basis, guaranteeing the Bhutanese government a net return of 15 percent above debt repayment and the project's operating cost. RGoB has developed the 60 MW

Figure 3-3 Identified storage projects



Note: HEP = Hydroelectric project.

Kurichhu, 336 MW Chukha, and 1,020 MW Tala hydropower projects in the past under this arrangement. All three projects were supported financially through a 60 percent grant and a 40 percent loan from the GoI. The terms of the loans are usually a 10 percent interest rate and a 12- to 15-year repayment period. Hydropower debt is directly serviced by DGPC, the government holding of publicly owned hydropower projects through the Ministry of Finance (MoF). In the case of the 1,200 MW Punatsangchhu I, 1,020 MW Punatsangchhu II and 720 MW Mangdechhu projects, the financing arrangements were different, with the GoI providing financing with less grant portions (Table 3-2). The 64 MW Basochhu hydropower project was developed by the RGoB, using a similar model, but with support from the government of Austria. The Austrian government provided a grant of 37.3 percent and a loan[4] of 49.0 percent while the rest of the financing was arranged by the RGoB.

- The *Joint-Venture (JV) model:* This is the model that was recently agreed by the RGoB and GoI, under which four projects with

[4] A Subsidiary Loan Agreement was signed between the Ministry of Finance (MoF) and the then Basochhu Hydro Power Corporation Limited (BHPCL) to transfer the loan availed by the MoF for the construction of the project to BHPCL. In accordance with the agreement, BHPCL is required to pay the MoF a consolidated annual fixed interest rate of 6 percent on the loan amount and outstanding from time to time. BHPCL shall repay the principal amount of the loan in 20 years, in equal annual installments in the case of Upper stage, while BHPCL shall pay the MoF, RGoB the principal loan amount in thirty equal consecutive semi-annual repayments in the case of the Lower stage of the project. The loan is denominated in Ngultrum and any foreign exchange fluctuation risk of the original loan between the Borrower and Lender shall be borne by the MoF, RGoB.

a total capacity of 2,120 MW have already been identified and for which a framework agreement has been signed. This includes the 600 MW Kholongchhu project,[5] the 180 MW Bunakha project, the 570 MW Wangchhu project, and the 770 MW Chamkharchhu-I project. Both Kholongchhu and Wangchhu have been allotted to Satluj Jal Vidyut Nigam Ltd (SJVN), while the National Hydroelectric Power Corporation (NHPC) and THDC India have been allotted Chamkharchhu-I and Bunakha, respectively. Under this model, the projects are being developed and commissioned under a Joint venture of DGPC[6] of Bhutan and India's Central Public Sector Undertakings (CPSUs) under a 50/50 percent ownership structure, with 70 percent of the project costs being raised as debt by the JVs from the market. The CPSUs will contribute their equity share from internal resources, while grants will be provided by the GoI to finance Bhutanese equity participation in these projects. Surplus power from these projects will be exported to India.

- The *Public-Private Partnership (PPP) model*: So far, two PPP projects have been developed with the support of the Asian Development Bank (ADB) and the government of Austria. This includes the 126 MW Dagachhu and 118 MW Nikachhu (under implementation) hydropower projects. The Nikachhu project will be built and managed by Tangsibji Hydro Energy Limited (THyE), a special purpose company owned by DGPC. DGPC intends to sell 26 percent of THyE to a foreign private company. The funding comes from ADB (in the form of grant, loan, and equity), DGPC, and other investors. THyE has already signed a 25-year power purchase agreement with the Power Trading Corporation of India, India's largest power trading company.

[5] Shareholders' agreement between DGPC and SJVN signed in September 2014, and JV registered in June 2015.

[6] The government holding for publicly owned hydropower projects.

Table 3-2 lists the development models and financing terms for the existing projects and for projects that currently have agreements in place. As indicated above, the three projects with general agreements—Wangchhu, Bunakha, and Chamkharchhu-I—are planned to be developed as JVs between DGPC and Indian partners Satluj Jal Vidyut Nigam Ltd. (SJVN), THDC, and NHPC, respectively. The projects under discussion, Sankosh, Kuri-Gongri and Amochhu, are envisaged as IG projects.

As India is the main market for the hydropower generated in Bhutan, a comprehensive transmission network is required to transmit power from Bhutan to India. The expected power grid is shown in Figure 3-4.

3.2 Institutions

The main stakeholders in the energy sector are shown in Figure 3-5. The principal RGoB administrator for hydropower development is the **Ministry of Economic Affairs (MoEA).** Under the MoEA, the **Department of Hydropower and Power Systems** (DHPS) overlooks the hydropower sector. The DHPS is responsible for the planning and development of large hydropower infrastructure (>25 MW), including transmission lines. Some of the main functions of the department are to govern and facilitate the optimal use of water resources for the development of hydropower; ensure that hydropower exports generate maximum revenue for the nation; and provide an enabling environment for participation of public and private sector actors in the development of hydropower resources.

Besides the institutions directly involved in the energy sector, the GNHC, the National Land Commission (NLC), and the Ministry of Home and Cultural Affairs (MoHCA) are important stakeholders in the development of hydropower.

Table 3-2 Hydropower projects in Bhutan—financing terms

Project name (capacity)	Development model	Financing arrangements		
		Grant	Loan	Equity
Tala (1,020 MW)	IG	60% by the GoI	40% by GoI (at a simple interest rate of 9% per year and repayable in 12 equated annual installments)	—
Chukha (336 MW)	IG	60% by the GoI	40% by GoI (at an interest rate of 5% per year and repayable over a period of 15 years in 30 installments)	—
Dagachhu (126 MW)	PPP		ADB; RZB, Austria; National Pension and Provident Fund or NPPF of Bhutan	DGPC (59%), Tata Power Company Limited of India (26%) and the NPPF of Bhutan (15%)
Basochhu (64 MW)	Austrian government	37.3%	49% by Austrian Government	13.7% (by RGoB)
Kurichhu (60 MW)	IG	60% by the GoI	40% by GoI (at a simple interest rate of 10.75% and repayable over a period of 12 years)	—
Punatsangchhu I (1,200 MW)	IG	40% by the GoI	60% by GoI (at an interest rate of 10% per year and repayable in 12 equated annual installments)	—
Punatsangchhu II (1,020 MW)	IG	30% by the GoI	70% by GoI (at an interest of 10% per year and repayable in 30 equated semi-annual installments)	—
Mangdechhu (720 MW)	IG	30% by the GoI	70% by GoI (at an interest of 10% per year and repayable in 30 equated semi-annual installments)	—
Nikachhu (118 MW)	PPP	US$ 25.25 million by ADB to part finance equity	65% loan: US$70 million from ADB's ordinary capital resource (OCR) with 3% interest, and another US$25.25 million loan from the Asian Development Fund with 1% interest during the grace period of eight years; INR 2.5 billion from State Bank of India (SBI) and INR 1.03 billion from EXIM Bank	35% equity: US$50.50 million, of which 50% is provided as a grant and the rest as a loan from ADB. The remaining equity share would be funded by DGPC
Kholongchhu (600 MW)	JV (with SJVN)	15% by the GoI (to fund equity portion of JV partner from Bhutan)	70% from commercial sources	30% (both JV partners bring in 50% equity). Equity share of JV partner from Bhutan funded by grant from the GoI

Source: DHPS and Internet.

Figure 3-4 Existing and planned transmission corridors

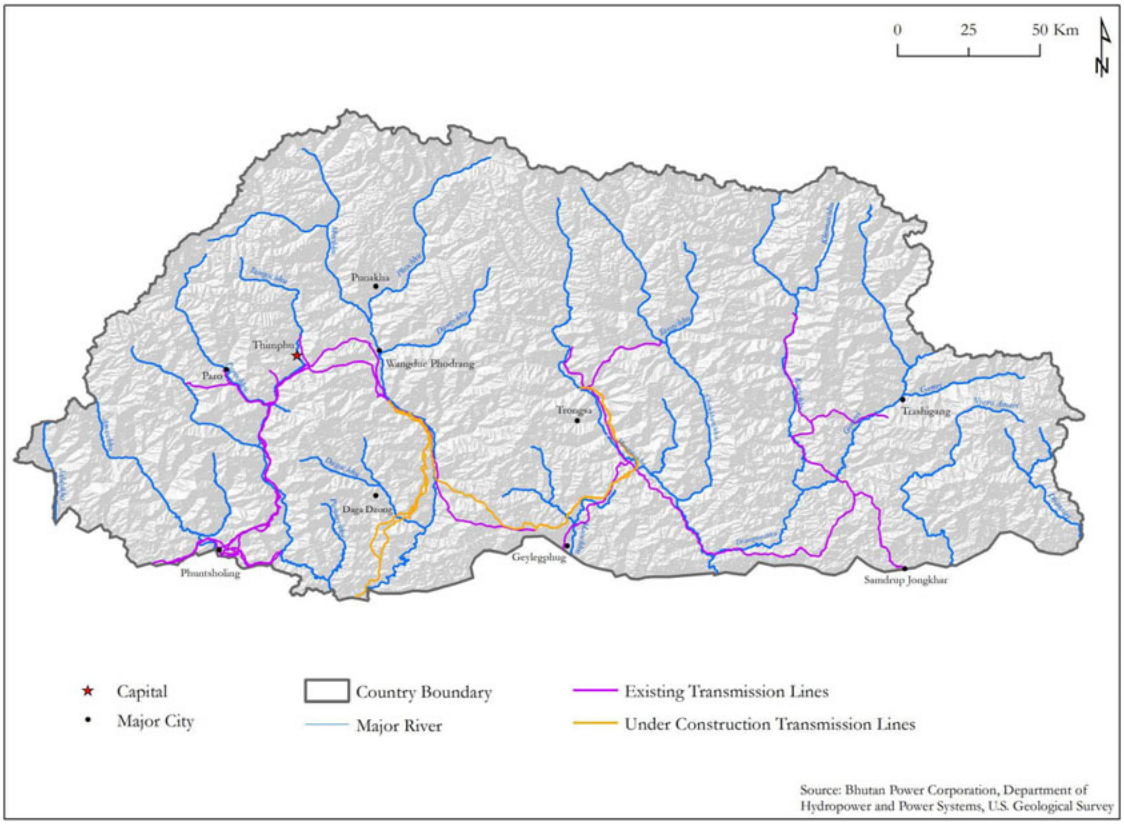
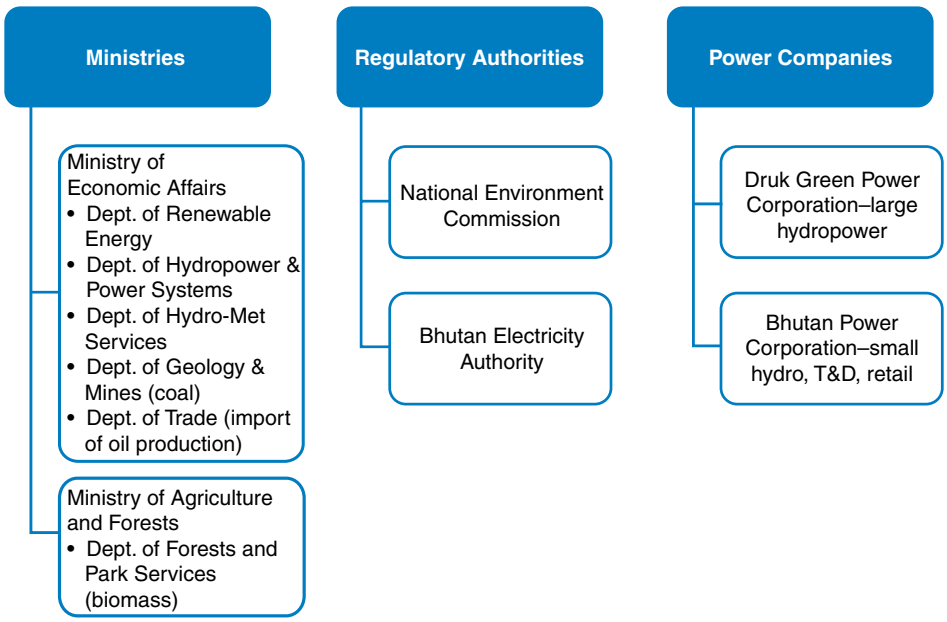


Figure 3-5 Primary stakeholders in the energy sector



The **Department of Renewable Energy** (DRE), under the MoEA, aims to promote all forms of available and viable renewable energy resources and technologies, other than large hydropower, while actively embracing energy conservation and efficiency measures. The department is responsible for the development of all renewable energy (RE) systems under 25 MW (including hydropower).

The **Department of Hydro-Met Services** (DHMS), also under the MoEA, is responsible for hydrological and meteorological data gathering and serves as the technical agency responsible for providing early warning of hydrometeorological hazards. The objective of the department is to observe and understand weather, climate, and hydrology to provide appropriate meteorological, hydrological, flood, glaciers, and related services in the country.

The **Ministry of Agriculture and Forests** (MoAF) is responsible for forestry, agriculture, and animal husbandry in the country. With 69 percent of the population living in rural areas and largely dependent on agriculture, one of the ministry's main objectives is the enhancement of rural livelihoods through improved agricultural productivity, development of agribusinesses and increased access to markets. The Ministry, through the **Department of Forests and Park Services,** is responsible for the conservation and sustainable use of forest resources, including the management of all watersheds in the country. The **National Centre of Aquaculture**, Department of Livestock, under the MoAF, runs fish conservation programs that are supported by hydropower projects through their EMP.

The **National Environment Commission** (NEC) is an independent body responsible for all matters relating to the environment. It develops, reviews, and revises environmental policies, plans and programs, and is responsible for formulating environment-related Laws/ Acts and monitoring enforcement of the same. It is also responsible for granting environmental clearances. In accordance with the environmental clearance regulations, the NEC Secretariat may appoint an Environmental Assessment Advisory Board to provide technical advice on the environmental assessment and the environmental terms of reference (TOR) for a project.

For hydropower projects, project proponents are required to submit an application form for environmental clearance with relevant No Objection Certificates (NOC) during the planning and design of the projects. On submission of the requisite documents, NEC determines if an environmental assessment (EA) is required and a TOR is finalized. Based on the EA, clearance may or may not be issued. The proponent is required to annually submit monitoring reports to NEC.

Other agencies from which NOCs may be required include the Department of Roads (if the project requires access from highways and feeder roads), the Department of Energy (if the project requires the relocation of a power transmission line), the Department of Culture (if the project is located within 50 m of a cultural or religious site), and the Nature Conservation Division, Department of Forests and Park Services (DFPS) (if the project lies within the boundaries of a Protected Area).

The **Bhutan Electricity Authority** (BEA) was initially established as a functional autonomous agency in accordance with section 7 of the Electricity Act of Bhutan, 2001, to restructure and regulate the electricity supply industry, to allow private sector participation in that industry, based on the policy approved by the RGoB, and to empower the government to create companies for carrying out all or any of the purpose of the Act. The BEA, however, was granted full autonomy by the government from January 2010. The Authority consists of four Commission members and a Chairman,

appointed by the Minister. The BEA's main functions are economic and technical regulation of power sector entities, including tariff setting and licensing.

The two major power companies in Bhutan are the **Druk Green Power Corporation** (DGPC), which owns and manages the large hydropower plants, and the **Bhutan Power Corporation** (BPC), which owns and operates power plants under 25 MW, operates the transmission and distribution systems, and retails electricity to customers.

- Druk Green Power Corporation is a holding company that is responsible for harnessing and sustaining Bhutan's RE resources. Druk Green was incorporated on January 1, 2008, with the vision to "promote, develop and manage renewable energy projects, particularly hydropower, in an efficient, responsible and sustainable manner, and to maximize wealth and revenue of the nation." It controls the four major hydroelectric projects (HEPs)—Chukha HEP, Basochhu HEP, Kurichhu HEP, and Tala HEP. It is by far the largest wholly owned corporate entity (with almost 1,800 employees) of Druk Holding and Investments (DHI),[7] the commercial arm of the RGoB. While Druk Green operates and maintains huge hydropower assets, its other key mandate is to promote and develop new hydropower stations. It retains 10 percent of the profit after tax from the existing hydropower plants for this purpose.
- The Bhutan Power Corporation was established as a public utility in July 2002 with the mandate of distributing electricity throughout the country and providing transmission access for generating stations for domestic supply as well as export.

The **Gross National Happiness Commission** (GNHC) is the government's central planning agency; it identifies and recommends priorities; manages the allocation of resources; sets targets; and coordinates, monitors, and evaluates policies and programs. The Commission is responsible for operationalizing Gross National Happiness by mainstreaming its elements into the country's plans and programs. More specifically, it is responsible for ensuring that national happiness is mainstreamed into the planning, policy making, and implementation process by evaluating their relevance to the framework of:

- Developing a dynamic economy as the foundation for a vibrant democracy;
- Harmonious Living: in harmony with tradition and nature;
- Effective and good governance; and
- Our people: investing in the nation's greatest asset.

The GNHC is overseeing and coordinating local livelihood programs implemented by hydropower projects with the government's overall development programs on the *Dzongkhag* level.

The **National Land Commission** (NLC) was established pursuant to Land Act 2007. The Land Act 2007 was enacted during the 87th Session of the National Assembly by revising the Land Act 1979. The NLC is an autonomous agency with 11 Commission members. The

[7] DHI is the commercial arm of the RGoB, established in 2007, "to hold and manage the existing and future investments of the Royal Government for the long term benefit of the people of Bhutan." DHI, the largest and only government-owned holding company in Bhutan, has shares in 18 different companies operating in the manufacturing, energy, natural resources, financial, communication, aviation, trading, and real estate sectors. Of the 18 companies, DHI holds 100 percent of shares in eight companies, which includes the two companies in the power sector, namely, BPC and DGPC. The Ministry of Finance is the sole shareholder of DHI.

Department of Survey and Land Records has become, by default, the NLC Secretariat with all its functional divisions. The Department was formally separated from the Ministry of Agriculture on August 15, 2007. The NLC delivers land governance services and provides reliable land information for the nation's well-being. Its mission includes: (i) to manage, regulate, and administer the ownership and use of land; (ii) to guarantee the security of land tenure; and (iii) to ensure easy access to reliable land information.

The **Ministry of Home and Cultural Affairs** (MHCA) aims to preserve, promote, develop, and protect the culture and heritage of the country. This ministry houses the Department of Culture, which is charged with inventorying and documenting cultural heritage; framing legislation and its management for conservation and protection of cultural heritage; and promoting cultural tourism. The MoHCA has embarked on a program to map all cultural assets of Bhutan. A cultural heritage bill has been drafted that lays out provisions for the developer in the case of infrastructure development. This act is under revision, but the timing of its approval is still uncertain.

3.3 Policies

Bhutan's development planning framework is guided by the development philosophy of Gross National Happiness (GNH), based on four pillars: sustainable and equitable socioeconomic development, preservation and promotion of culture, conservation and sustainable utilization and management of the environment, and promotion of good governance. The foundational legislation and policy context of hydropower development in Bhutan provide substantial focus on E&S issues (Table 3-3).

Table 3-3 Key environmental laws, policies, and instruments for hydropower development

Laws/policies	Relevant issues/provisions
Development Policies	
Electricity Act (2001)	Provides the institutional framework for the governance of the electricity sector in Bhutan.
Bhutan Sustainable Hydropower Development Policy (2008)	Provides the framework and guidelines for accelerated hydropower development in the country. The policy allows the RGoB to develop hydropower projects with public, private, or public-private participation and in collaboration with governments of development partner countries. It contains a provision for a Renewable Energy Development Fund to support preparatory activities as well as environmental services; a minimum of 12 percent of electricity generated to be provided free of cost as Royalty Energy; a minimum of 1 percent of royalty energy in cash to be made available annually for Integrated Sustainable Water Resources Management; foreign companies are allowed to bring in expatriate personnel in areas where there is a shortage of Bhutanese with requisite skills but are required to provide employment to one member of each of the displaced families. Project Developer to make provisions for mitigation of adverse impacts in accordance with EIA report through EMP.
Economic Development Policy (2010)	Guided by the overarching philosophy of Gross National. Specifically relating to the energy sector—15 percent of total power generation to be provided as free "royalty energy;" develop strategic plan for capacity building of Bhutanese in construction of hydropower projects; subsidies for in-country training and employment of Bhutanese.
Foreign Direct Investment Policy (2010)	Supports private sector participation in the development of medium and large hydropower projects and other RE projects, and provides incentives for foreign entities to invest in Bhutan's energy sector.
Bhutan Renewable Energy (RE) Policy (2012, draft)	Provides the RGoB's objectives for developing the RE sector and provides the policy framework to address key issues relating to the promotion of RE and public and private sector participation in the development of RE projects.

Laws/policies	Relevant issues/provisions
Social Policies	
Land Act (2007)	National Land Commission responsible for policies and programs, acquisition of registered land and its allotment; compensation for land acquisition will be fair and can include substitute land or cash; acquisition of land occupied by religious monuments will be avoided; location of substitute land will be in order of preference of same village, Gewog, Dzongkhag. Land owner will have no preference over location of substitute land provided by the government; land valuation done by a Property Assessment and Valuation Agency under the MoF; compensation to be provided for immovable property on acquired land.
Social Safeguards Manual of DGPC	Provides standardized guidelines relating to social safeguard measures, procedures, and principles to ensure that hydropower projects are "developed in a socially responsible manner and according to sound internationally accepted practices."
Environmental Policies	
National Environment Protection Act (2007)	Fundamental right of citizens to a safe and healthy environment and government's duty to protect environmental well-being; polluter pays principle; right to information and access to justice; principle of sovereign rights of the state; principle of payment for environmental services; responsibility of National Environment Commission or competent authorities to independently regulate and promote sustainable development.
Water Act of Bhutan (2011)	The RGoB as the public trustee of the nation's water resources; right to access safe, affordable, and sufficient water for basic human needs; polluter and user pays principle; formulation of a "National Integrated Water Resources Management Plan;" minimum environmental flow requirements for watercourses; water use priorities—drinking and sanitation, agriculture, energy, industry, tourism and recreation, and for other uses.
Forest and Nature Conservation Act (1995)	Forest management, prohibitions and concessions in government-reserved forests, forestry leases, social and community forestry, transport and trade of forestry produce, protected areas, wildlife conservation, soil and water conservation. Any developmental activity within a protected area needs to carry out an Environmental Impact Assessment.
Biodiversity Act (2003)	Formulated in line with the provisions of the Convention on Biological Diversity taking into account the biological resources of the country. It ensures the national sovereignty of the country over genetic resources in accordance with relevant national and international law.
Forest and Nature Conservation Rules (2006)	Describes regulations related to government reserved forests, protected area management, wildlife conservation, enforcement, and penalties.
The Water Regulation of Bhutan (2014)	For the effective enforcement of the objectives and purposes of the Water Act of Bhutan 2011. Lists functions of competent authorities; EIA to determine environmental flows (e-flows); otherwise, at a minimum, it should be 30 percent of lean season flow; no development activities are allowed within a buffer zone of one hundred feet of any water body without an environmental clearance; dams to have fish passages or other measures to allow fish movement.
Environmental and Social Impact Assessment	
Environmental Assessment Act (2000)	Establishes procedures for assessment of policies, plans, and projects on the environment; environmental clearance by the National Environment Commission (NEC) or a competent authority required and mandatory; public consultation made mandatory; provisions included for noncompliance, including penalties.
Regulation for the Environmental Clearance of Projects (2002)	NEC and/or "competent authority" given the responsibility for issuing environmental clearance; public consultations mandatory.
EA Guideline for Hydropower (2012)	Includes specific guidelines for assisting practitioners in conducting an environmental assessment of a hydropower project and accordingly develop mitigation measures, including recommended outline and content for EMPs, Resettlement and Rehabilitation (R&R) Plans, Compensatory Afforestation Plans, Environmental Flow Assessment, Dam Break Analysis and Disaster Management Plan, and Biodiversity Conservation & Wildlife Management Plan, among others.

3.4 Current planning methodology

The hydropower projects currently under development and the pipeline of new projects are the result of an evolving planning process by the RGoB. An important basis for this process was the Update of the Power System Master Plan (PSMP) of 2004, which in turn was an update of the 1993 master plan. The PSMP (2004) updated information on all potential projects identified in the 1993 study, ranked these, and proposed the development of seven priority projects for the period 2003–22. The projects under construction today—Punatsangchhu I and II, and Mangdechhu—were on this list, as well as three of the projects included in the 10,000 MW Program (Kholongchhu, Chamkharchhu-I, and Amochhu).

A fundamental presumption for the master plan was to develop hydropower in Bhutan for export to India, since India's power market is vast compared to the domestic market. It is recognized that hydropower projects in Bhutan face competition from Indian and Nepalese hydropower projects, as the latter have similar topographical and hydrological advantages. The cost of Bhutanese hydropower projects must, therefore, be competitive. It was also acknowledged, however, that Bhutan's comparative advantage in hydropower lies in its ability to create an institutional framework and investment environment that would enable export-oriented projects to be implemented more easily than in India and Nepal.

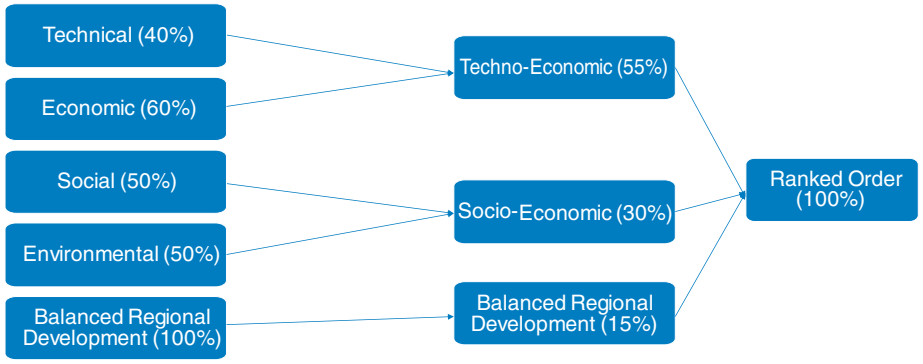
The master plan was developed on par with international standards, with technical studies conducted by Norconsult of Norway and with the Norwegian Water Resources and Energy Directorate as technical adviser. It was developed as part of an integrated Water Resources Management Plan for Bhutan through a consultative process involving members of the Bhutan Water Partnership (BWP) and government institutions, including the Department of Energy (predecessor to DHPS and DRE), NEC, and BPC.

Environmental studies were conducted independently of the technical studies, both for the potential hydropower projects and the development of the transmission line system in Bhutan. The potential hydropower projects were subjected to an Initial Environmental Examination, which was used as input to a Multi-Criteria Analysis (MCA) to rank the projects. In the final ranking, however, the stakeholders emphasized that "*selection of the Projects for further development will be governed to some extent by political consideration and also the preferences of the buyer,*" and that economic merit would carry strong weight.

Subsequent to the 2004 master plan, the RGoB adopted the approach of the MCA as the main tool for prioritizing projects for further study and development. While the basic principles for the MCA were taken from the 2004 study's approach, the methodology was further customized to the Bhutanese context. As an example, a new criterion, "Balanced Regional Development," was introduced to take into account the increased interest from remote regions/districts to develop hydropower in their area to distribute the increased business opportunities more evenly across the country. The adoption of this criterion has resulted in prioritization of hydropower development in the eastern part of Bhutan over further development in the Wangchhu River. The latter might have been preferable from a technical and economical point of view because it would have been possible to operate projects in cascade and use existing transmission corridors of the Chukha and Tala projects.

Figure 3-6 Factors and weights used in multi-criteria analysis for new hydropower development

Main criteria	Technical	Economic	Social	Environmental	Balanced regional development
Sub-criteria	Hydrological quality	Economic merit	Improved access to socio-economic benefits	Intrusion into protected areas	Population to be benefited
	Geological risk	Transmission line cost	Access to reliable & adequate power supply	Loss of primary forest	Existing planned hydropower projects in the Dzongkhag
	Dam cost risk	Financeability	Employment benefits	Dewatering impacts	Poverty level
	GLOF risk		Rehabilitation & resettlement	Access road erosion	Literacy rate
	Site accessibility		Tourism	Fish migration	Health coverage
	Transmission line risk				Site remoteness
	Reservoir sedimentation				



Source: DHPS.

Note: GLOF = Glacial Lake Outburst Flood.

The factors and weights the DHPS currently uses in the MCA are shown in Figure 3-6. Minutes from DHPS meetings show that the individual weights are critically reviewed, discussed, and set for each analysis of a new set of projects. Typically, 3–4 projects are studied and compared through the MCA, and the best scoring projects are proposed for further study (prefeasibility and subsequent DPR, if prefeasibility study confirms viability).

The score for each of the main criteria is computed as the weighted sum of the subcriteria. Table 3-4 shows the standard weights recently used for the subcriteria. The large number of criteria shows that the RGoB is well aware of the complexity of hydropower development and the many variables that need to be taken into account. The disadvantage of using so many criteria is the dilution of the possibility for any single criterion, one that may be critical, to affect the overall score.

Table 3-4 Standard weights for the subcriteria used in the MCA

Criteria & weights				
Criteria	**Sub-criteria**	**Weights**	**Weights**	**Weights**
1 Technical				
	1.1 Hydrological quality	22%		
	1.2 Geological risk	25%		
	1.3 Dam cost risk	15%		
	1.4 GLOF risk	6%		
	1.5 Site accessibility	14%		
	1.6 Transmission line risk	14%		
	1.7 Reservoir sedimentation	4%		
	Sub-total:	**100%**	**40%**	
2 Economic				
	2.1 Economic merit	65%		
	1.6 Transmission line cost	20%		
	2.2 Financeability	15%		
	Sub-total:	**100%**	**60%**	
	Total Technical & Economic		**100%**	**100%**
3 Social				
	3.1 Improved access to socio-economic benefits	35%		
	3.2 Access to reliable & adequate power supply	10%		
	3.3 Employment benefits	25%		
	3.4 R & R	20%		
	3.5 Tourism	10%		
	Sub-total:	**100%**	**50%**	
4 Environmental				
	4.1 Intrusion into protected areas	40%		
	4.2 Loss of primary forest	35%		
	4.3 Dewatering impacts	10%		
	4.4 Access road erosion	10%		
	4.5 Fish migration	5%		
	Sub-total:	**100%**	**50%**	
	Total Social & Environmental		**100%**	**30%**
5 Development				
	5.1 Balanced regional development	**100%**	**100%**	**15%**
	Total Overall:			**100%**

Source: DHPS.

Note: MCA = Multi-Criteria Analysis; GLOF = Glacier Lake Outburst Flood; R&R = Resettlement and Rehabilitation.

Chapter 4
Analysis of Key Issues for Management of Environmental and Social Impacts

The purpose of this chapter is to identify the most relevant E&S impacts of current and planned hydropower development in Bhutan. It aims to (i) assess how Bhutan is doing so far in managing these impacts and (ii) identify the key issues for improvement of policies, institutions, and practices.

This chapter is the result of an assessment of RGoB's policies, processes, and experience in the management of E&S impacts, based on desk reviews, extensive interviews with stakeholders, and field visits to a number of hydropower facilities currently in operation and under construction. It also takes into account the findings of (i) the geographical analysis of planned hydropower development in the country, which provides an assessment of the potential environmental, social, and cultural footprint (Appendix B); (ii) a rapid institutional assessment of the key organizations involved in hydropower development in Bhutan (Appendix C); and (iii) the Hydropower Sustainability Assessment of the Mangdechhu Hydroelectric Project (Appendix D).

4.1 Environmental impacts

Relevance

Conservation and sustainable utilization and management of the environment is one of the four pillars of Bhutan's unique development philosophy based on the promotion of gross national happiness. The Constitution of Bhutan mandates that the country maintain at least 60 percent of its land area under forest cover, when in fact forests cover over 70 percent of the total land in the country, a testament to the importance placed on this natural asset. Bhutan's pristine environment also contributes to the country's economic growth. Forests support rural livelihoods. Rural households rely on forests for subsistence goods, including fuel wood, nonwood forest products, construction timber, etc. Tourism is the second biggest sector in the economy after hydropower, and Bhutan's relatively untouched nature is one of the reasons international tourists like visiting the country. Recreational fishing is offered by many tour operators along with visits to Bhutan's iconic cultural sites located in, often untouched, landscapes. Managing the impacts of hydropower on the environment is, therefore, essential.

A diverse range of adverse environmental impacts can result from hydropower development. Impacts vary depending on the project's type, size, and sensitivity of the project site. Typical environmental impacts of hydropower projects are presented in Table 4-1. While some impacts occur only during construction, the most important impacts are usually due to the long-term existence and operation of the dam and reservoir, and intake and generation facilities. Other significant impacts on the environment can result from ancillary works such as access roads, power transmission lines, and quarries and borrow pits.

Major downriver hydrological changes brought about by hydropower facilities can destroy riparian ecosystems dependent on periodic natural flooding, and exacerbate water pollution during low flow periods. Reduced sediment and nutrient loads downriver can similarly increase river-edge erosion and damage the biological and economic productivity of rivers. Induced desiccation of rivers below dams (when the water is diverted to another portion of the river or to a different river) can also reduce water supplies for agriculture and other human activities.

Though facilities with reservoirs can positively affect certain fish species (and fisheries) by increasing the area of available aquatic habitat, the net impacts are often negative for several reasons: (i) the dam blocks upriver fish migrations, while downriver passage through turbines or over spillways is often unsuccessful; (ii) many river-adapted fish and other aquatic species cannot survive in artificial lakes; (iii) changes in downriver flow patterns adversely affect many species; and (iv) water quality deterioration in or below reservoirs (usually low oxygen levels; sometimes gas super-saturation) can kill fish and damage aquatic habitats. Freshwater mollusks, crustaceans, and other benthic organisms are even more sensitive to these changes than most fish species, because of their limited mobility.

Hydropower plants can also affect biodiversity through habitat fragmentation or the destruction of habitats altogether. Such impacts can be direct, because of the footprint of hydropower schemes, including the ancillary infrastructure (access roads, residential complex, nonresidential complex, contractor facility and workshops, and disposal sites), or indirect, as a consequence of opening up adjacent areas

Table 4-1 Typical environmental impacts of hydropower plants

Hydropower plant type	Main negative environmental impacts
Run-of-river	Relatively small terrestrial footprints and impacts on surrounding environments. However, potentially large impact on aquatic biodiversity due to affected river connectivity, especially when constructed in cascades. Barrier for fish migration and sediment transport. If constructed as a diversion scheme, reduced water flow between intake and tailrace affects river and riparian ecology. Even if powerhouse is located at the toe of the dam, potential impacts on downstream river ecology due to rapid changes in runoff during ramp-up and ramp-down. Influx of construction workers has local environmental impacts. Habitat fragmentation due to new access roads and other ancillary structures.
Reservoir (storage)	Large alteration of natural environment by impoundment resulting in impacts on both terrestrial and aquatic ecosystems and biodiversity. Barrier for fish migration and sediment transport. Significant modification of volume and seasonal patterns of downstream river flows. Large impacts on river ecology at immediate stretch downstream of dam during ramp-up and ramp-down. Changes in water temperature and quality, and related GHG emissions. Large influx of construction workers has local environmental impacts. Habitat fragmentation due to reservoir, access roads, and other ancillary structures.

through access roads built for construction purposes. Vegetation removal often leads to the loss of plants, which have their own biological value but also provide food and cover for many birds and animals. Opening up of remote areas can also lead to an increase in poaching.

Current impacts in Bhutan

The extent to which the impacts described above are likely to materialize in Bhutan depends on many factors. The most important one, and the one that can limit the significance of impacts, is the fact that the majority of projects are run-of-river projects with very small inundation areas. Moreover, given the vast and well-established network of protected areas and biological corridors, any terrestrial footprint of current and planned hydropower plants is likely to be a small fraction of the area under protection. Conversely, these facilities are likely to have a greater impact on aquatic ecosystems and aquatic life by way of changes in river flows and river fragmentation. Geographical analysis of the likely environmental footprint of hydropower projects in Bhutan lends support to these conclusions. The analysis shows that existing projects and those for which advanced preparation is underway affect only a limited area covered by protected areas and biological corridors. Encroachment into protected areas and corridors becomes a bigger concern for the projects in the longer-term pipeline, that is, those in the prefeasibility and reconnaissance phase, some of which are inside or very close to protected areas. As seen in Figure 4-1, however, the absolute impact on protected areas from hydropower facilities, measured by area affected, is still estimated to be minimal. That said, the lack of baseline data on terrestrial biodiversity makes it difficult to say conclusively what the impact will be, even if it is likely to be relatively small.

Of much greater concern is the impact on aquatic connectivity and ecosystems. With the existing installed hydropower capacity in Bhutan, approximately 90 percent of the river network is free-flowing (see Table 4-2 and Appendix B for more details). If all the projects that are being studied at the prefeasibility and reconnaissance phase are developed, the free-flowing river network could be reduced to 50 percent of the total system. The length of river for which the flow regime will be altered dramatically, that is, the length of the reservoir together with the stretch of river between the intake structure and the outlet, will also increase significantly (Table 4-2 and Figure 4-2). Currently, this affected river stretch stands at 68.6 km but, as the projects under construction come online, this figure will more than double. With the introduction of the remaining projects in the 10,000 MW Program, this fragmentation will increase by a factor of seven.

Fragmentation of river ecosystems can affect both physical variables, such as flow regime and water quality, and the productivity and species composition of different rivers. Because there is little baseline information on fish species

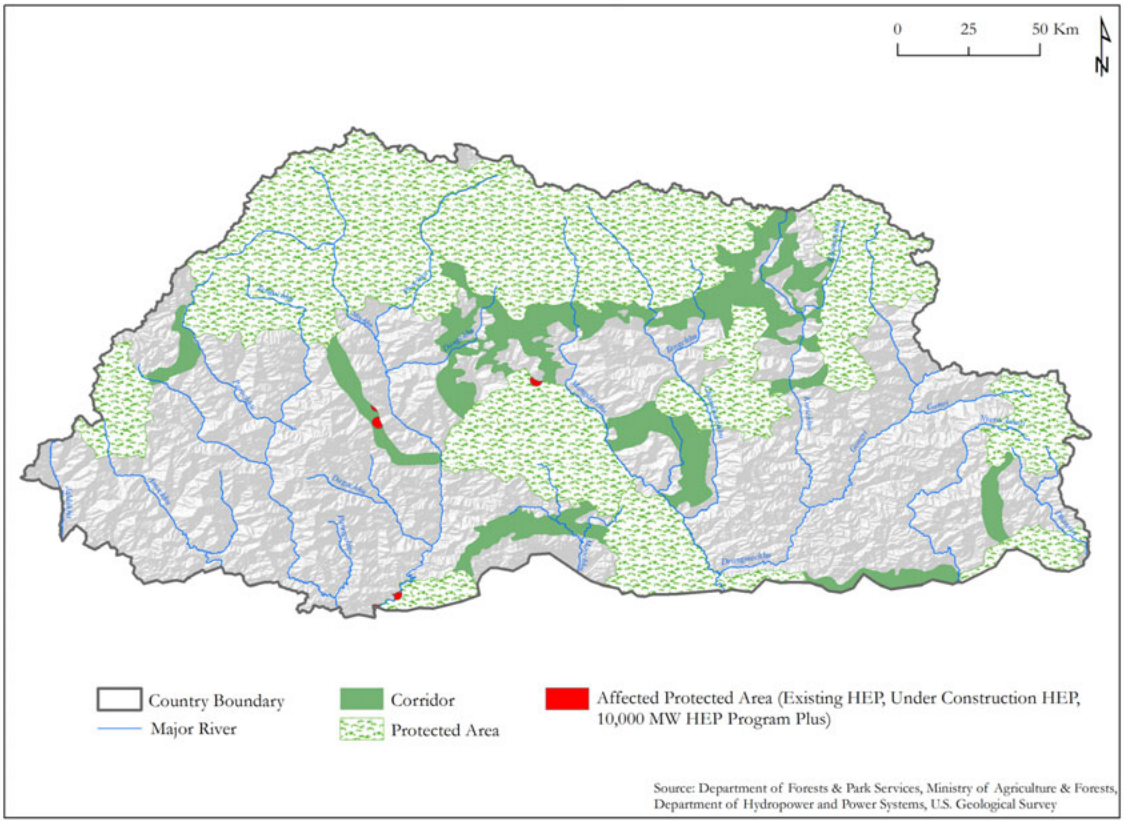
Table 4-2 River length affected by hydropower project

Indicator (cumulative)	Existing	+ Under construction	+ 10,000 MW Plus Program	+ Prefeasibility/ reconnaissance
Installed capacity (MW)	1,606	5,264	14,196	21,191
Affected river stretch (km)	68.6	162.4	501.2	953.9
Free-flowing river stretch (km)	1,931	1,652	1,495	1,099
Free-flowing river (%)	89	76	69	50

Source: Bank analysis

Note: HEP = Hydroelectric project.

Figure 4-1 Protected areas and corridors affected by existing and planned hydropower facilities

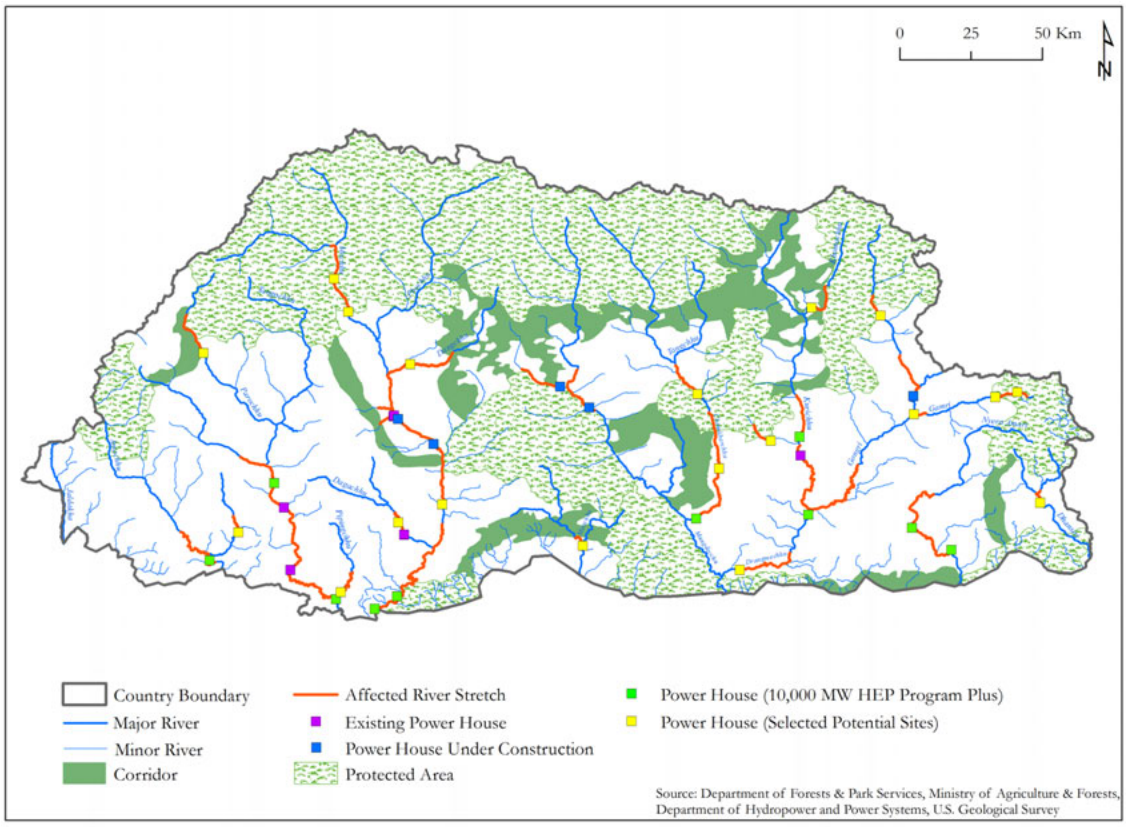


Note: HEP = Hydroelectric project.

diversity in Bhutan, it is difficult to fully assess the potential impacts of river fragmentation on aquatic biodiversity. At present, Bhutan has around 93 species but this number is expected to increase to 100 as more taxa are identified. Moreover, the first fish species endemic to Bhutan was recently discovered (*Parachiloglanis bhutanensis*). Moreover, very little is known about the ecology of migratory species, that is, their migratory triggers and habitat preferences.

The National Environment Protection Act, 2007 focuses on the "principle of 3 Rs" in order to forestall or limit environmental impact. These principles are: (i) the "polluter pays principle" for protecting against and mitigating adverse impacts; (ii) the "sovereign rights principle," sovereign rights over renewable and nonrenewable natural resources being vested in the state; and (iii) the "principle of payment for environmental services," where the person using or extracting natural resources has to pay for ecosystem/environmental services. For projects that may have a negative impact on the environment, the Environmental Assessment Act (2000) requires that environmental clearances be obtained from various competent authorities, including the Ministry of Agriculture and Forests for removal of vegetation, the Department of Geology and Mines for quarries, and the Department of Roads for road construction and widening. The procedures for obtaining clearances from different authorities are rigorous and well-defined, with each clearance specifying conditions for approval that must be complied with, and provisions for periodic renewal and monitoring by the respective regulatory

Figure 4-2 Affected river stretches for planned large hydropower up to 21,191 MW



Note: HEP = Hydroelectric project.

authorities. These requirements for obtaining clearances are also detailed in the Regulation for the Environmental Clearance of Projects (2002).

Current management practices in Bhutan

Rules and Regulations: Bhutan's rules and regulations for addressing and managing the environmental impacts of hydropower are comprehensive and robust. The Constitution of Bhutan has designated every Bhutanese citizen as a trustee of the Kingdom's natural resources and environment. Accordingly, a series of laws and policies have been enacted to ensure the protection, conservation, and sustainability of the natural environment.

As will be discussed in greater length in the next section, the Environmental Impact Assessment is legislated under the Environmental Assessment Act (2000) and regulated by NEC. For hydropower development in Bhutan, also separate guidelines (Environmental Assessment Guideline for Power Transmission Line Guideline (2012) and Environmental Assessment Guideline for Hydropower Development (2012)) were published.

In addition to these broad regulations related to the environment, the regulatory framework also comprises specific rules and regulations related to water use, biodiversity, fisheries, and forestry. The Water Act of Bhutan, 2011, follows the "polluter/user pays principle" while also requiring a number of measures to be adopted, including formulation of a "National Integrated Water Resources Management Plan" and a "River Basin Management Plan" for each river basin. It stipulates water use priorities—drinking water and sanitation and agriculture being prioritized over use in energy production. It

also vests the responsibility for implementation of the Act in the Bhutan Electricity Authority for hydropower generation and in NEC for abstraction and use of water and for monitoring the overall compliance. The Water Regulation of Bhutan, 2014 requires the EIAs to recommend the prescribed environmental flows for a hydropower project.[8] If the minimum flow is not recommended by the EIA, then the Water Regulations prescribes a default minimum of 30 percent of the lean flow. The Water Regulations also require dams in Bhutan to have fish passages or other measures to allow fish movement.

These rules and regulations provide adequate basis for protecting and managing Bhutan's natural and human environment. The current legislative framework has a few gaps, however, and these are elaborated below.

Early Planning: As seen in Chapter 3, the RGoB currently uses MCA for inclusion of projects in the master plan with weightage points for the four thematic areas (technical, economic, social, and environment) considered in hydropower development. Positive and negative environmental impacts are assessed during the planning process, and their merits and disadvantages are considered in the ranking process. Important environmental impacts, such as intrusion into protected areas, loss of primary forest, erosion, and fish migration, are considered in the MCA. However, greater weight is assigned to technical and economic criteria, which often outweigh single environmental factors in the planning decisions.

Impact Assessment: In accordance with the Environment Assessment Act (2000), and as is standard practice globally, once a particular hydropower plant has been selected for further studies, an Environmental Impact Assessment (EIA) and Environment Management Plan (EMP) are used to assess the potential impacts on the environment and to prescribe mitigation measures, respectively.

In 2012, to guide the preparation of E&S impact assessment studies for hydropower development, guidelines (*Environmental Assessment—Guidelines for Hydropower* and *Environmental Assessment—Guidelines for Power Transmission Line Projects)* were issued.[9] The guidelines include measures to identify, assess, and mitigate environmental impacts from hydropower development, as well as provide a framework for the preparation of good assessment reports. Six key steps are recommended: (i) screening; (ii) scoping; (iii) baseline data generation; (iv) impact assessment; (v) measures for mitigation of impacts; and (vi) Environmental Management Plan. The highlights of these guidelines are the following:

- The concept of screening and scoping to identify key issues to be included in the assessments;
- The need for consultations with affected communities;
- The need to assess impacts downstream and on ecological flows;
- The need to assess impacts on cultural heritage;
- The need to manage construction impacts.

Although the guidelines are comprehensive, they are unclear in a few areas. For instance, no guidance is given on assessment of cumulative impacts, which is especially important when hydropower projects are built in cascades; Nor do the guidelines include a requirement for developers to prepare compliance frameworks

[8] Prior to the Water Act of 2011, which required the NEC to set the minimum environmental flows for watercourses, environmental flows were set at 10 percent of the lean season flow.

[9] Guidelines also exist for social assessments; they are discussed in Section 4.2.

for mitigation measures, especially important during the construction phase.

Furthermore, the quality of these guidelines is not always reflected in the *practice* of environmental impact assessments in Bhutan, which are often also inconsistent across projects. The ways in which environment issues have been addressed in the NHPP and MHEP projects are very different, for example. While this is expected because NHPP is being supported by the ADB, and thus involves different requirements, the varying quality of the reports does indicate that the assessments are not always done in accordance with the specifications of the regulations and the provisions of the guidelines.

An assessment of EIAs for a number of hydropower projects in the country[10] found the following common shortcomings:

- Lack of baseline data to properly assess the impacts on natural habitats, especially aquatic ecosystems;
- A descriptive approach and an overemphasis on construction impacts, with a lack of assessment of the impacts of some ancillary infrastructures such as roads, and little discussion of the possible impacts on culturally significant sites;
- Lack of detailed mitigation measures or site-specific management plans: in the case of many issues, it is only "recommended" or suggested that they be looked at;
- Lack of a systematic approach to assessing the impact on environmental flows, with different projects doing so in different ways (setting a percentage of lean flows, maintaining a minimum depth downstream, etc.).
- Lack of comprehensive compliance frameworks.

[10] Nikachhu, Punatsangchhu-I, Chamkharchhu I,

These observed weaknesses in the EIA reports were corroborated by the independent review underpinning the Hydropower Sustainability Assessment of the Mangdechhu Hydroelectric Project (appendix D). This assessment also found weaknesses in the EIA report, namely:

- Lack of information on the methodologies or criteria used to determine the impacts of the project;
- No formal assessment of the significance of the potential impacts and no scoping of cumulative impacts or transboundary issues (the Mangdechhu River flows into the Manas River, which crosses over into India downstream from the project site). By contrast, the Nikachhu Hydropower Project ESIA includes a brief section on cumulative impacts and a series of matrices summarizing potential impacts and their significance;
- Only a qualitative description of the potential impacts associated with construction is given, not a detailed evaluation;
- Lack of use of local expertise for the individual field studies.

The narrowness of EIA scope and underutilization of local expertise have resulted in some issues being ignored or quickly dismissed, which has sometimes led to management challenges during project implementation. In the case of MHEP, issues such as dust, waste, and blasting had not been sufficiently covered by the EIA or subsequent EMP. Consequently, the project authority had to come up with solutions as problems arose rather than putting in place adequate management plans ahead of time. Similarly, the late timing of EIAs in some instances has reduced the scope to avoid and minimize negative impacts. In the case of MHEP, the EIA/EMP was finalized in 2011, after the DPR, which was completed in 2008, meaning that the final design of the project could not be informed by the findings of the EIA. The weaknesses in the environmental

assessment reports are further exacerbated by the lack of an effective compliance framework during implementation. Monitoring of E&S provisions as outlined in the mitigation plans such as the EMPs also seems to be weak and is not done on a regular basis.[11]

Another noted departure from international good practice is that the EIAs and EMPs are not always disclosed to the public in Bhutan. The Environmental Assessment Act, 2000[12] requires that once the environmental clearance has been obtained, project-related information, including a project description, measures for mitigating adverse impacts, and the rationale for authorizing the project, be made available to the public.[13] However, the existing regulations and guidelines are largely silent on the modality for disclosure (that is, medium, location, language). Further, while NEC is tasked with the responsibility to disclose EIAs and EMPs and to do so online, lack of manpower has been cited as a constraint limiting these disclosures.

Mitigation Measures: The impact of river fragmentation on aquatic fauna and habitats will be strongly influenced by the level at which the residual or minimum environmental flow is set. These impacts could in principle be reduced, especially during the dry season, if residual flows are set at a level that is compatible with maintaining the integrity of the aquatic environment downstream.

The Environmental Assessment Guidelines for Hydropower Projects establish a multilayer approach for estimating environmental flows, following international good practices. The Guidelines recommend that calculations be carried out scientifically, taking into account not just the ecological requirements but also social and cultural requirements. Four different methods are suggested:

- *Hydrology based*: Sets flow on assumption that maintaining some percentage of the natural flow will keep the river wet and fulfill all requirements;
- *Hydraulic rating:* Measures changes in the river flow, based on a single cross-section (perimeter, depth, velocity) to assess changes in the habitat affected by it;
- *Habitat simulation:* Employs multiple cross-sections to the hydraulic model rating to simulate the conditions in a given stretch of the river;
- *Holistic methodologies:* Employs a multidisciplinary approach to provide a consensus view. The team could include hydrologists, biologists, geo-morphologists, water quality specialists, and socio-economists.

So far, however, this approach has not been applied in Bhutan. Most EIAs take a simple hydrological approach or, as in one case, define the environmental flow based on a required depth of the river downstream and a water velocity "suitable" for fish (Table 4-3). Supported by the Austrian government, NEC is in the process of developing revised regulations and guidelines for estimating environmental flows for hydropower projects. This guidance will detail the methodologies and tools to apply in the multilayer approach described above.

Another concern is the lack of systems to verify whether projects are making environmental releases according to levels prescribed in EIAs or the default minimum. The lack of data risks creating distrust regarding whether environmental flow releases will, in fact, be followed.

[11] NEC was not able to provide the team any monitoring reports, for example.
[12] Likewise, the National Environment Protection Act, 2007, also establishes the right of be informed about the state of the environment and all activities that could affect the environment.
[13] See Chapter IV, Article 28, of the Environmental Assessment Act, 2000.

Table 4-3 E-flow prescriptions in the EIA reports for projects

Project	Environmental flows
Chamkharchhu-I	EIA: minimum environmental flow is required. EMP: methodologies for e-flows are explained. Building Block methodology is adopted defining minimum flows for 4 seasons: • Season 1 (Monsoon): 20% average flow • Season 2:(Average Flow): 15% • Season 3 (Low Season): 10% • Season 4 (Average Flow): 15% State Discharge relationships are used to calculate minimum flows for estimating depth of flows. A minimum depth of 0.5 m is assumed without reference to any source.
Punatsangchhu-I	River will have limited flows downstream the dam; there will be no impacts on downstream users, however. For sustenance of riverine fisheries, a minimum flow of 2.5 m^3/s was estimated: • A rule-of-thumb of minimum depth of 0.5 m required for Himalayan fish (not justified, no source is mentioned.) • 40 m wide river stretch.
Nikachhu	Restates the approach required in EIA Guidelines. Relies on downstream tributaries to complement flows. Proposes 10% of average lean flow of 90% dependable year.

Flow regulation is also an important aspect when the power plant functions as a peaking plant. The sudden stop and start of flow through the turbines creates a very rapid change of flows that can be harmful for biodiversity downstream of the tailrace. Peaking can also create landslides and affect riparian ecology at the reservoir, as the level rapidly decreases during peak power production hours. The use of a minimum time for ramping up and ramping down to create a smooth transition is important to avoid negative impacts on biodiversity.

Regardless of ecological flow regulations, dams are an impassable barrier for migratory fish, potentially depleting populations past critical thresholds, eventually affecting the biodiversity of the river. Consequently, and as already mentioned, the Water Regulation of Bhutan (2014) stipulates that dams shall have fish passages or other measures to allow fish movement.

At present, the practice in Bhutan has been to recommend mitigation measures for the impacts on fish based on quantity (stocking through fish nurseries), rather than maintaining fish connectivity (Table 4-4). Artificial seed production in hatcheries to stock river stretches downstream and upstream of the proposed dam is probably the most recommended mitigation action for fish impacts. However, the restocking programs are recommended without prior assessment of the impacts (positive or negative) on biodiversity or identification of a need for this restocking.

There are exceptions, including an ongoing aquatic biodiversity assessment program for the Mangdechhu River, focused on monitoring benthic fauna and its response to the MHEP project construction and later operation. Beyond the direct impacts of the project, the MHEP also supports an activity with the National Centre for Aquaculture on the conservation of Golden Mahseer, including breeding and reintroduction of fish in the river. The Kurichhu dam (85 m high) does includes a fish passage. This pool and weir passage is based on a traditional model and consists of 98 baffles placed 2 meters apart, with submerged orifices and centrally located notches. In addition to questions on the fit of

Table 4-4 Fish impact mitigation measures in the EIA reports for projects

Project	Fish impacts
Chamkharchhu-I	Dam will hinder migration, especially of *Schizothorax spp.* Dam is 108 m high; hence, fish ladders are not feasible. Artificial fish production in hatchery to stock upstream and downstream of dam. Fish hatchery to be managed by Department of Livestock.
Punatsangchhu-I	Dam will hinder fish movement, especially for mahseer. Dam is 63 m high; therefore, fish ladder is not very effective. Proposed mitigation: artificial stocking *of Schizothorax progastus* of upstream and downstream segments. Flow through fish farm is proposed.
Nikachhu	Presence of introduced brown trout (*Salmo tuta*). Fish habitat downstream of dam is not affected. No fish migration because of waterfalls. Reservoir will provide opportunity for stocking with snow trout. No fish program is proposed.

the physical characteristics of this structure (25 cm orifices) with the target fish species (large Mahseer fish), there is no monitoring of the efficiency or efficacy of the passage in terms of the maintenance of healthy fish populations upstream or downstream of the dam.

Finally, catchment management plans, which include compensatory afforestation, are identified as a priority issue related to water use and conservation needs specific to the watershed in a number of EIA reports. There are provisions, at least in the NHPP, to prepare a Catchment Management Plan as part of the EMP. It is not clear from the EMP, however, which authority would be responsible for implementing and monitoring the development of such catchment management plans. The Ministry of Agriculture and Forests (MoAF), which is responsible in Bhutan for ensuring sustainable watershed management through catchment protection and conservation work, has not been involved in such measures in hydropower projects.[14]

Institutions and capacity: The key institutions responsible for managing the environmental impacts of hydropower are NEC, the DHPS, and the Dzongkhag Environmental Officers (DEOs) (Appendix C). In addition, the project developer (so far, this has been either DGPC or a Special Purpose Vehicle) and operator (DGPC) have essential roles. The DHPS is responsible for early planning and supports the developers in the environmental assessment and permit process. NEC and DEO, as regulatory bodies, give clearances and check compliance. The developer and operator are responsible for executing the EIA and EMP, in part, through the owner's engineer and contractors.

The Environmental Assessment Act (2000) requires that Environmental Clearances (ECs) be obtained for projects that may have adverse impacts on the environment. The EC process in Bhutan consists of a series of clearances to be obtained from the various competent authorities such as, but not limited to, the National Land Commission Secretariat (NLCS), which provides clearances for land acquisition, and the Ministry of Agriculture and Forests (MoAF), which provides clearances for works involving removal of vegetation. The clearance process concludes with the release of the umbrella environmental clearance (EC) from NEC, once all other clearances are obtained, including EIA clearance. In line with the requirements of the

[14] Meeting with Department of Agriculture, MoAF, October 8, 2015.

Table 4-5 Afforestation measures in the EIA/EMP reports for select projects

Project	Compensatory afforestation
Chamkharchhu-I	• Compensatory afforestation in area twice the size of the forest area affected by the project; • Afforestation in low- and medium-eroded subwatersheds in the catchment area; • Afforestation to be carried out by the Department of Forests in areas near the project; • Compensatory afforestation to be implemented along with other soil conservation measures and fencing.
Punatsangchhu-I	• Compensatory forestation for total forest loss through submergence, construction of other appurtenance, temporary facility and disposal area, and alignment of transmission line; • Afforestation to be carried out in degraded forest patches in and around project area amounting to double the amount of forest land affected; • Indigenous species for afforestation to be selected by the Department of Forests and paid for by the project authorities.
Nikachhu	• Specifies timing for cutting trees (i.e., during dry season before most animals begin to breed and before the monsoon, which causes additional damage and muddy runoff in the forest); • Compensation planting of trees in area that is twice the size of the area cleared, while allowing for up to 40 percent damage or mortality; • Monitoring and replacement of saplings to ensure high survival rate for afforestation; • Tree planting not only to be carried out in the project work areas, but also in other barren areas, locations that would support upper catchment protection, and tourist destinations; • Appropriateness of tree species to be determined in consultation with the Department of Forests.

Regulation for the Environmental Clearance of Projects, 2012, once the detailed designs are finalized, the EIA is prepared by the project proponent, and submitted for clearance to NEC.

In the case of the Mangdechhu Hydroelectric Project, the following levels of clearances were required before the overall or "umbrella" Environmental Clearance (EC) was issued:

- Notice of Consent from families affected by land acquisition (153 households);
- Clearances for land acquisition from the NLCS;
- Clearances for road development and widening from Department of Roads (DoR);
- Clearances for quarries from Department of Geology and Mines (DGM);
- Clearances for works involving removal of vegetation from the Ministry of Agriculture and Forests (MoAF);
- Clearances from the *Dzongkhag* Administration Trongsa (DAT).

Obtaining project clearances is a well-defined, rigorous process that identifies the competent authorities who are responsible for compliance oversight throughout the life of the project. Each clearance includes conditions for approval that the project must comply with. In Bhutan, each person affected by land acquisition is required to provide a Notice of Consent and only then is a clearance for land acquisition issued by NLCS. As described previously, NEC has issued guidelines for EIAs to facilitate the clearance process.

The capacity of government institutions is constrained, which results in delays, despite the clarity of the process. This is especially the case for NEC, which has few staff[15] and limited resources to issue environmental clearances, carry out baseline studies, and do

[15] The Environmental Services Division of NEC, responsible for all infrastructure projects including roads and the large number of hydropower projects, is severely understaffed (it has about four employees). Staff is in charge of reviewing all EIAs and granting environmental clearance.

regular monitoring. The present mechanism for reviewing EIA reports includes the reports being sent to other department reviewers for comments. Pursuing these reviewers has been a difficult task, forcing the NEC staff, at times, to decide without the benefit of subject matter expertise from other disciplines. Under the Regulation for the Environmental Clearance of Projects (2002), there is also a provision for establishing the Environmental Assessment Advisory Board (EAAB), but this mechanism has not been used. Typically, the EC validity for a hydropower project is only two years. If there are technical or financial challenges that delay the project, it is likely that the EC will need to be obtained once more even before project commencement. If there are changes or modifications to a project, the NECS must conduct a site visit, which is often a source of delays because of their limited manpower. The EIA review process could definitely be strengthened and streamlined.

On the compliance side, it is the role of the NECS's Compliance Monitoring Division to ensure compliance with the provisions of the laws, regulations, and conditions of the EC. The environmental departments of the hydropower authorities are required to send monthly reports, and a complete compliance report on an annual basis. Regular compliance monitoring throughout the project life, including site visits, is typically done by the DEOs, regulators who report to the *Dzongkhag* Administration (DA) and not to the NECS. This can, at times, be a source of conflict given different priorities of the NECS and the DEOs. The DEOs purportedly are also constrained in their capacity, especially to carry out field visits, in those situations where NEC has devolved responsibility; this has created a backlog of requests and hinders the compliance monitoring process.

Another challenge is that NEC is functioning both as a regulator and a policy formulation and planning agency. Despite the current lack of manpower for meeting clearance and compliance requirements, the same staff are, to a large extent, involved in studies such as those pertaining to e-flows. This is further constraining the time that staff can devote to their core regulatory functions.

The DHPS also faces constraints since, at present, it has no staff dedicated to the departments responsible for E&S management. A common pool of staff manages E&S issues as a part of their other responsibilities. However, some capacity building has been formally undertaken to support these staff.

On the other hand, the capacity of developers and operators for environmental management is generally good. DGPC has an Environmental Unit under the Projects Department, which was established to coordinate the preparation of prefeasibility, feasibility, technical, and DPR studies for pipeline projects. This Environmental Unit has six officers, all of them science graduates. It supports the EIA studies for projects currently being developed by DGPC and also the existing hydropower plants under operation. Projects developed through the IG approach all have SPVs, which have environmental units in their organizations. The MHPA, which is developing the Mangdechhu Hydroelectric Project, has an environmental unit with 10 staff. There is also an exchange program involving DGPC staff and staff from the projects currently being developed. Two officers in the DGPC Environmental Unit have been seconded to the Mangdechhu and Nikachhu projects to gain field experience.

Key issues

The absence of strategic early planning has been marked as one of the main gaps in the current environmental impact management practices in Bhutan. The current MCA approach used for planning of new hydropower, based mainly on local factors, tends to limit the possibility to consider regional or national perspectives. To reach the level of international good practice, the project-by-project planning

approach for hydropower in Bhutan needs to be enhanced by a strategic, long-term approach that includes basin-level planning and assessment of cumulative impacts. Basin-scale environmental assessments and planning can reduce the scope of the assessments and planning needed at the project level. Such strategic upstream plans can ensure that project proposals are set within a policy framework that has already been subject to environmental scrutiny, reducing the scope of the environmental issues that need to be assessed and addressed at the level of individual project EIAs.

Many tools are becoming available for upstream planning of hydropower development. Hydropower-by-Design is an approach that looks at an entire river basin and the impacts a dam will have both upstream and downstream. It focuses on more balanced development scenarios that allow for energy production while maintaining vital river functions. It aims to avoid developing the potentially most damaging hydropower dam sites and instead develop sites that will have lower impacts; minimize impacts and restore key river functions through better design and operation of individual dams; and offset those impacts that cannot be avoided, minimized, or restored by investing in compensation measures such as protection and management of nearby rivers that provide similar benefits. Box 4-1 gives an example of early hydropower planning in the Coatzacoalcos basin in Mexico.

In a similar vein, cumulative environmental impacts on the river ecology may become more significant in the future and will need to be understood. No major environmental impacts have been reported for the existing hydropower projects, which are all run-of-river. However, with numerous hydropower projects planned across multiple basins, the cumulative and synergistic environmental impacts may become significant. Project-level EIAs fail to assess the potential cumulative effects on environmental resources. For instance, the impact of a particular project on an environmental resource may be insignificant when assessed in isolation, but significant when evaluated in the context of the combined effect of all past, present, and reasonably foreseeable future activities that may have or have had an impact on the resources in question. Therefore, the assessment of cumulative effects is now considered desirable in environmental assessment practice in many countries.

The key potential environmental impact related to hydropower development in Bhutan is with regards to aquatic biodiversity. The geographical analysis shows that the terrestrial footprint of hydropower in Bhutan is likely to be small. The majority of hydropower projects are run-of-river and even the proposed storage projects have relatively small reservoirs because of the extreme topography of Bhutan, characterized by very deep valleys. Most planned hydropower projects, and especially the ones in the short-term pipeline, have almost no impact on protected areas. While new transmission lines will cross protected areas, they are planned to be built parallel to already built-out corridors (see Section 4.3 on transmission lines). Nevertheless, the geographical analysis shows that by causing river fragmentation and altering flow regimes, hydropower development will have an impact on aquatic biodiversity.

Basin-level planning and cumulative impact assessment should focus on how best to maintain aquatic biodiversity while growing the hydropower sector. The impacts of fragmentation on aquatic ecosystems can be mitigated and compensated more effectively at the basin level. When a number of projects are planned within the same river system, proposing hatcheries and fish-stocking programs for *each* project may not be the best way to achieve the desired outcome of maintaining healthy fish populations. By assessing the *cumulative* effects on fish populations, a *national* fish program can be designed instead to mitigate the impacts.

Box 4-1 Upstream Hydropower Planning in the Coatzacoalcos Basin in Mexico

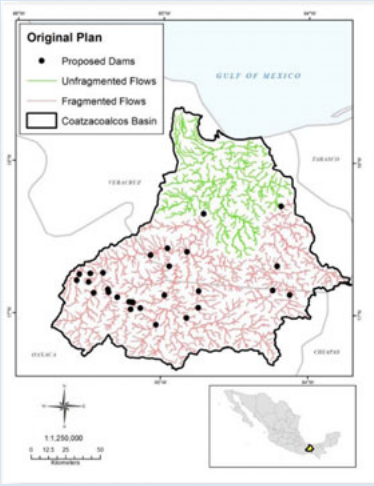
The biologically and socially diverse Coatzacoalcos river basin of Mexico is part of the government of Mexico's hydropower expansion plan. The basin is rich in biodiversity—having a wide variety of species and ecosystems of ecological interest, including threatened, endangered, and endemic species such as the jaguar (*Panthera onca*). The Chimalpas forest is of great genetic value in Mexico and Mesoamerica, and it is estimated that one hectare of undisturbed tropical vegetation in the Chimalpas has about 900 flora species and over 200 fauna species. To minimize impacts on the environment and protect the cultural interests, a pilot Hydropower by Design (HbD) strategy in the basin was applied through a partnership between the Federal Commission of Electricity (CFE) and The Nature Conservancy. This entailed evaluating each project based on its technical, environmental, and social feasibility.

Early strategic planning process to identify projects that are environmentally, socially, and economically sound was based on the concept of Hydropower by Design (HbD). The analysis involved eight steps:

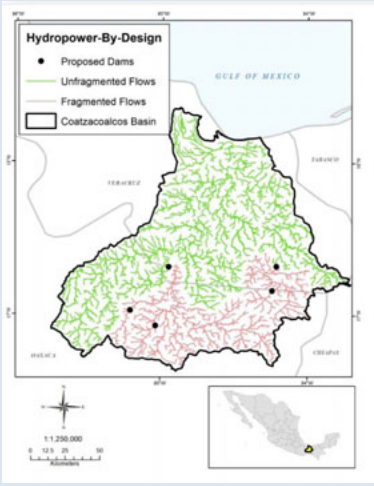
- Identifying the hydroelectric potential of the basin; Establishing a working group;
- Establishing a geographic information system;
- Selecting criteria and metrics that facilitate evaluation of projects, scenario creation, and decision making
- Geographical analysis of the watershed;
- Multi-criteria analysis to determine the viability of the projects;
- Fragmentation or connectivity analysis;
- Developing the sustainability portfolio.

A total of 28 projects were identified in the basin and different scenarios were generated. These projects all have (i) a capacity greater than 1 MW and (ii) up to more than 100 MW for (iii) a total maximum potential of 511 MW. Through the application of the HbD methodology, only 5 projects (172 MW) were identified that met all three criteria—environmentally, socially, and economically sound—inverting the impact on the basin from 70 percent of river flows fragmented to 70 percent of river flows unfragmented, thereby greatly reducing the threat to the surrounding Chimalpas rainforest and other areas.

Experience from this approach demonstrates that comprehensive watershed planning at an early stage can offer sustainable options for potential investment in hydropower projects. Comprehensive watershed planning can facilitate complying with international commitments on climate change and biodiversity, and meeting targets for power generation. Interagency collaboration is necessary for developing environmentally sound and viable proposals. Through smart planning at the river basin scale, a country or region can have *both* major hydroelectric infrastructure development *and* preserve E&S values derived from rivers.



Potential projects. Unfragmented flows are shown in green.



Proposed portfolio. Unfragmented flows are shown in green.

Source: World Bank. Modified from Barajas, N., V. Aguilar, V. Morales, D. Vázquez , P. Petry, E. Bastida, J. Bezaury-Creel, O. Calahorra, J. Capitaine, J. P. García, F. Inguanzo, M. Heiner, H. Jiménez, E. Martin, J. Opperman, H. Rodríguez, L. Sotomayor, R. Tharme, J. F. Torres, J. Touval y L. Vázquez. 2014. Planeación temprana para el desarrollo de proyectos hidroeléctricos sustentables: marco metodológico y caso piloto en la cuenca del Río Coatzacoalcos, México. Comisión Federal de Electricidad, Comisión Nacional para el Conocimiento y Uso de la Biodiversidad y The Nature Conservancy. México.

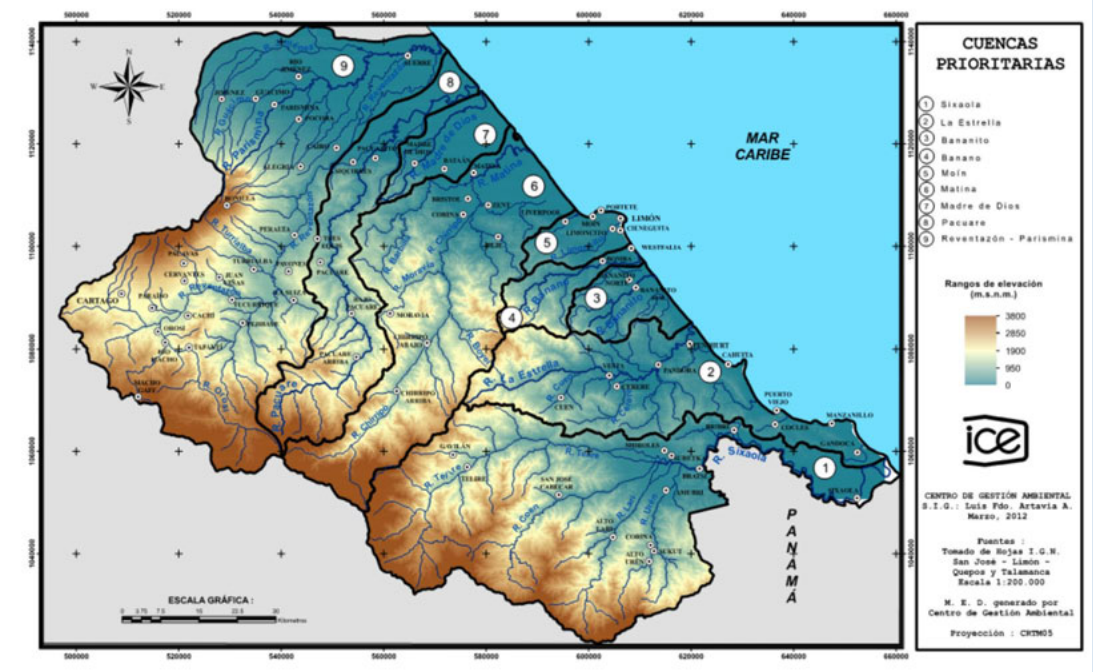
A more strategic approach aimed at maintaining the highest level of connectivity while also achieving the highest level of power generation might very well yield a more cost-effective approach to managing river fragmentation (Box 4-2 gives an example of a strategic

Box 4-2 More Strategic Approach to Maintaining Fish Biodiversity

The impact of hydropower on fish habitats and migration of fish has proven to be an elusive issue in many countries, despite considerable investments in hatcheries and fish-stocking programs on a project-by-project basis. In many cases, however, this method has failed to achieve the desired outcomes of maintaining healthy fish populations and fish biodiversity in the watersheds. While fish stocking resolves issues related to fish numbers, it does not resolve the more significant problem of maintaining fish biodiversity in a given river ecosystem. In addition, fish hatcheries, while maintaining the presence of a number of "individuals" in a segment of the river, often focus on a single species, mainly one with some human consumption or recreational potential. This selective stocking does not provide for a balanced ecosystem.

Offsets, in particular aquatic offsets for hydropower projects, are gaining traction worldwide. These are measures taken to compensate for any residual significant, adverse impacts that cannot be avoided, minimized and/or restored, in order to avoid a net loss or net gain of biodiversity. These can be positive management interventions such as restoration of degraded habitat or protecting areas with imminent or projected loss of biodiversity. Compensatory measures are primarily meant to provide value equivalent to that which has been damaged at the same location and, secondarily, provide other environmental value to another place. Any compensatory measure should be connected with the negative impact that has been identified and the affected party ought to benefit from the measure. Dams on the Reventazón River in Costa Rica and the Chaglla Hydroelectric Project in Peru have implemented measures to protect an entire river as an offset.

The Reventazón Hydropower Project in Costa Rica plans to implement a protected river corridor with no barriers to connectivity in a river system that is ecologically similar to that of the Reventazón. This is to compensate for the residual impacts of the project on the river, compounded by the cumulative impacts of upstream projects and other river uses. Nine major rivers flowing into the Caribbean were evaluated for their characteristics, and the Parismina River, which is currently undammed, was chosen. By sacrificing only 5 MW of 10,000 MW, Costa Rica was able to allow for a free-flowing river and thereby meet both hydropower development and biodiversity conservation goals.



Source: World Bank. Modified from Integrated Environments, Ltd. Propuesta de Proyecto de Compensacion de Bodiversidad: Proyecto Hidroelectrico, Reventazon. Instituto Costaricense de Electricidad, ICE. 2013. (Proposal for a Biodiversity Compensation Project: Reventazon Hydroelectric Project).

approach to maintaining fish biodiversity). In this manner, *individual* projects can address mitigation measures through ecological flows in the immediate downstream stretches of the dam without having to assess *overall* connectivity issues in the EIA. Such an approach can greatly simplify the EIA process while guaranteeing the long-term preservation of fish biodiversity and migratory functions in Bhutan.

It should be pointed out that the effects on aquatic biodiversity are not fully understood, mainly because there are few baseline studies. Moreover, the effectiveness of existing mitigation measures, such as environmental flow releases, hatchery programs, and fish passages is, to a large extent, unknown because aquatic biodiversity is not being monitored. Better assessments of the impacts on aquatic biodiversity and formulation, implementation, and monitoring of robust mitigation plans will be important.

The key potential environmental impact related to hydropower development in Bhutan has to do with aquatic biodiversity. The geographical analysis shows that the terrestrial footprint of hydropower in Bhutan is likely to be small. The majority of hydropower projects are run-of-river and even the proposed storage projects have relatively small reservoirs because of the extreme topography of Bhutan, characterized by very deep valleys. Most planned hydropower projects, and especially the ones in the short-term pipeline, have almost no impact on protected areas. While new transmission lines will cross protected areas, they are planned to be built parallel to already built-out corridors (see Section 4.3 on transmission lines). Nevertheless, the geographical analysis shows that by causing river fragmentation and altering flow regimes, hydropower development will have an impact on aquatic biodiversity.

Basin-level planning and cumulative impact assessment should focus on how best to maintain aquatic biodiversity while growing the hydropower sector. The impacts of fragmentation on aquatic ecosystems can be mitigated and compensated more effectively at the basin level. When a number of projects are planned within the same river system, proposing hatcheries and fish-stocking programs for *each* project may not be the best way to achieve the desired outcome of maintaining healthy fish populations. By assessing the *cumulative* effects on fish populations, a *national* fish program can be designed instead to mitigate the impacts. A more strategic approach aimed at maintaining the highest level of connectivity while also achieving the highest level of power generation might very well yield a more cost-effective approach to managing river fragmentation (Box 4-2 gives an example of a strategic approach to maintaining fish biodiversity). In this manner, *individual* projects can address mitigation measures through ecological flows in the immediate downstream stretches of the dam without having to assess *overall* connectivity issues in the EIA. Such an approach can greatly simplify the EIA process while guaranteeing the long-term preservation of fish biodiversity and migratory functions in Bhutan.

It should be pointed out that the effects on aquatic biodiversity are not fully understood, mainly because there are few baseline studies. Moreover, the effectiveness of existing mitigation measures, such as environmental flow releases, hatchery programs, and fish passages is, to a large extent, unknown because aquatic biodiversity is not being monitored. Better assessments of the impacts on aquatic biodiversity and formulation, implementation, and monitoring of robust mitigation plans will be important.

The need to strengthen the capacity of NEC and nodal agencies is considered key to addressing the weaknesses in implementation of environmental assessments for hydropower development in Bhutan. The parallel

identification of constrained institutional capacities with key organizations involved in the environmental management of hydropower in Bhutan, and weaknesses in the implementation of EIAs and in the review process, despite a generally good regulatory framework, is not a coincidence. A stronger and more streamlined quality assurance and clearance process is likely to improve the varying quality of environmental assessments. Quality assurance by DHPS and the developers needs to be enhanced to produce good-quality EIAs and EMPs, including compliance frameworks. NEC, in its regulatory function, needs to build capacity to identify gaps in the preparation studies and suggested mitigation measures. Developing a roster of experts to provide sectoral expertise and review the EIAs in a timely manner; implementing an online management system for providing environmental clearances and compliance monitoring; and providing indicative times for environmental clearances are all ways in which the process could be streamlined. Finally, improved coordination with other ministries is required, among others, coordination with the MoAF on catchment area management, and with the Department of Fisheries on aquatic biodiversity, to ensure that the right thematic experts are consulted and sectoral plans are aligned.

A related capacity issue for the management of environmental impacts of hydropower in Bhutan is the lack of baseline data and the consequent lack of capacity of the regulatory agencies and other stakeholders to assess and monitor the long-term impacts on natural values. Analysis of long-term trends in biodiversity requires good baseline data and regular monitoring. Though a number of efforts are underway,[16] comprehensive baseline data are very limited in Bhutan, especially outside the protected areas. Scientific literature on native fish species in Bhutan reports a poor state of knowledge on diversity. Lack of baseline data was reported by NEC as one of the main challenges in conducting environmental impact assessments. Similarly, no data are available on the effects of existing hydropower facilities on biodiversity.

4.2 Social impacts and cultural assets

Relevance

The major social impacts of hydropower development (Table 4-6) are impacts on livelihoods caused by transformation of land use in the project area and the displacement of people. Global experience has shown that resettlement is immensely disruptive to the communities affected and can cause long-term impacts on livelihood and well-being. Therefore, mitigation measures should be developed to ensure that the livelihoods and living standards of those affected are maintained, and if possible, improved relative to preproject conditions.

In Bhutan, the natural features—steep valleys and deep gorges—render direct impacts on people and property relatively limited compared with many other countries. The geographical areas where hydropower projects are located are often sparsely inhabited, and most hydropower projects are run-of-river projects with very small inundation areas. Besides loss of land and livelihoods, the impacts on physical cultural resources are important, given that they are sources of valuable scientific and historical information; they are assets for economic and social development and form an integral part of a people's cultural identity. Again, the risk of impacts on cultural heritage is low due to hydropower's relatively small footprint in Bhutan. However, these impacts, albeit minimal, need to be well managed in order to maintain

[16] The National Centre for Riverine and Lake Fisheries is undertaking a Fish-Fauna Assessment; and WWF is conducting an assessment of Golden Masheer in the Manas river basin, mapping its migratory route using satellite telemetry.

Table 4-6 Typical social impacts from hydropower plants

Hydropower plant type	Main negative social impacts
Run-of-river	Has relatively small footprints and impacts on surrounding environments and communities; need for relocation of individuals and communities is limited, and impact on farmlands is small. If constructed as a diversion scheme, water flow is reduced between intake and tailrace, affecting the livelihood of water-dependent communities. Influx of construction workers has social, economic, cultural and health impacts.
Reservoir (storage)	Alteration of human environment by impoundment resulting in potentially significant impacts on human settlements, livelihoods and well-being, as well as population displacement and resettlement; landscape changes and loss of physical and cultural heritage and assets; Potential conflicts with host communities, due to land use change, and impacts on agroproduction, particularly downstream. Large influx of construction workers likely to cause social, health, economic, and cultural problems at the local community level. Potentially limited access because the reservoir acts as a barrier to land transport.

the livelihoods of affected households and the country's high cultural values.

Current impacts in Bhutan

The displacement impacts of hydropower projects to date have been minimal because project footprints have been small and projects are located in sparsely populated areas. Landscape changes have also been limited, with areas affected by projects normally being in the order of only a few hundred hectares per project (Table 4-7). Furthermore, projects mostly acquire government reserve forestland, and only a limited amount of private land (see

Table 4-7 Land acquisition under different projects

	Chamkharchhu-I	Nikachhu	Mangdechhu	Punatsangchhu-I
Total land requirement (ha)	697.46	101.5	325.15	542.28
Government reserve forest land (ha)	689.76	100.07	296.68	424.38[a]
Total private land (ha) *(% total land acquired)*	7.70 (1.10)	1.43[b] (1.41)	28.47[c] (8.75)	117.9[d] (21.74)
Kamzhing (dry land) (ha)	7.70	1.69	5.2	—
Chhuzhing (wet/irrigated land) (ha)	NA	NA	3.23	—
Tseri (jhum) (ha)	NA	NA	6.23	—
Pangzhing (grass fallow land) (ha)	NA	NA	3.81	—
Tshoesa (vegetable garden) (ha)	NA	NA	0.07	—
House and land (physical relocation)	0	0	0	5 households
Only land	34 households	17 households +1 community private school	49 households	24 households

Note: a. The EIA for Punatsangchhu-I does not specify exactly the amount of government land that will be acquired. However, given that the total area of land needed is 542.28 ha and 117.9 of it is private land, it is assumed that the remainder will be government reserve forest. b. The EIA for Nikachhu specifically mentions that this land requirement is for project roads and dam colony. c. At the time of the EIA preparation, data and information collected through the survey and Trongsa Dzong government officials, revealed that while the total private land within the project area is 28.47 ha, the area of private land whose owners could be identified was only 18.54 ha. d. The EIA for Punatsangchhu-I provides a breakdown of the different types of land to be acquired from the affected *geogs*. However, the information is not consistent (e.g., Gasetsho Gom *geog,* only about 3.35 acres of *chuzhing* (paddy field) and about 0.75 acres of *kamzhing* (dry land) are likely to be affected; in Daga *geog*, temporary acquisition of *kamzhing* (dry land), but disaggregated information for the different land types is not provided for Daga). The scale of government land to be used for the project is not specified either.

Table 4-8 Impact on vulnerable groups

Project	Identified vulnerable groups
Chamkharchhu-I	Women and children living in the project area are targeted for measures to enhance the living standards.
Punatsangchhu-I	5 of the 29 project-affected households that need to be resettled are considered vulnerable because they would be losing their houses in addition to land.
Nikachhu	3 of the 17 households are considered vulnerable because they are poor, female-headed, or include someone with a disability.

Table 4-7 for private land as a percentage of total land acquired). Even then, concerns have been expressed about the availability of sufficient land that maintains similar livelihood opportunities for resettled and other affected people given the large hydropower development pipeline. Much of the land in the country is dedicated to forests, and areas suitable for agriculture, which provide livelihood for a majority of Bhutan's population, are limited.

Besides those directly affected by loss of private lands due to acquisition, others may be affected indirectly by the building of access roads, especially in the areas that are not connected to the existing road network. People are also affected by the construction of ancillary structures such as residential and nonresidential structures; construction facilities and contractor establishments; and muck disposal sites. The extent of these impacts is not always known because their assessment varies across EIA reports. Similarly, hydropower projects may also affect the livelihood of households and communities in the villages beyond those whose land was by the project. For example, while the Mangdechhu Hydroelectric Project acquired mostly government land and very little private land, the communities in Trongsa Dzongkhag who had been using the government land as grazing land saw their livelihoods negatively affected.

It is also important to take into account the potential impacts on vulnerable groups. In the case of Bhutan, there is no overarching definition of vulnerable groups but, in general, women, children, the elderly, unemployed youths, indigenous peoples, social minorities, the disabled, and the very poor are considered vulnerable. The EIA reports reviewed employ different definitions of vulnerable groups, and the assessment of impacts on the "vulnerable groups" are not detailed, resulting in mitigation measures that are also weak (Table 4-8). For instance, the EIA for MHEP refers to the presence of "15–20 households" belonging to the Monpa community in the project areas, but the assessment does not contain specific details on how these households would be affected by the project and neither does the EMP include any provisions to mitigate possible risks or impacts.[17]

No major impacts on cultural heritage from the existing hydropower plants have been reported in the EIAs. This may, in part, be explained by the lack of clear demarcations of heritage sites. Only impacts on national monuments tend to be considered, and thus, those sites that are not nationally recognized but might be of value to local communities are not always taken into account. The EIA for Nikachhu mentions that there are no impacts on physical and cultural resources since the nearest cultural resource is 6 km away in Chendebji, possibly having disregarded the many places, sites, and objects that do have historical, cultural, and local significance. In fact, during public consultations, impacts on sites of cultural significance have

[17] See "Socioeconomic and Cultural Status," Chapter 10 of the ESIA.

Table 4-9 Cultural assets affected by hydropower projects[a]

Indicator (cumulative)	Existing	+ Under construction	+ 10,000 MW Program Plus	+ Prefeasibility/ reconnaissance
Installed capacity (MW)	1,606	5,264	14,196	21,191
Affected historical sites (#)	7	10	21	38

Source: Bank Analysis.

Note: a. See Appendix B for more details.

been reported, but not necessarily captured in the EIA.[18]

This is not to say that projects ignore the significance of nearby cultural sites and their potential impacts on them. In the Mangdechhu project, for example, discussions held among the project authority, *Dzongkhag* officials, and project-affected communities, identified additional structures of cultural significance that had not been previously considered in the EIA. Similarly, the project has made significant investments in the preservation and restoration of certain cultural sites, including seismic monitoring at the Trongsa Dzong, renovation of the Dzong, redevelopment of traditional archery grounds, and lighting projects for the Kuengarabten Nunnery and Dandung temple. The lack of any comprehensive assessment of these issues as well as opportunities in the EIA, however, especially considering that in this society cultural heritage is a key aspect of national identity, limits the ability of projects to avoid or at least minimize their impacts on physical and nonphysical cultural heritage.

A geographical analysis of the mapped historical sites shows some major sites—such as monuments, Dzongs, museums, and monasteries—lie within the impact area of the projects (Table 4-9). However, the number of affected historical sites is small compared with the 1,776 sites in total that are currently listed in the national database (Appendix B).

Current management practices in Bhutan

Effective management of social issues requires that: (i) impacts be identified and assessed early in the project cycle; (ii) plans be developed and implemented to avoid, minimize, mitigate, or compensate for the potential adverse impacts; and (iii) affected people be informed and consulted during project preparation and implementation.

Rules and Regulations: In Bhutan, the rules and regulations for managing the social impacts

[18] For example, during a publication consultation meeting held at Thajong ORC for the Chamkharchhu-I HEP, the following was reported, "*Public expressed their concern that Nimshong Rock Quarry (CHR-2) may need to be reviewed for its inclusion in the DPR as they strongly believe that local deities known to them as 'Aulegphog sen' resides in the tree. . . . It is said that all the proposed quarry area is abode and therefore under his dominance. Till date nobody dares to fell a tree or disturbs its sanctity as they feared dreadful eventuality.*" During another consultation for the Chamkharchhu project, it was mentioned, "*A chorten—Hopong Chorten—that is seen just above the proposed area is said to be built by their forefathers to subdue and bring its nuisance under control.*" Despite these concerns raised during public consultations, the EIA report for Chamkharchhu-I mentions that the proposed project will not affect any cultural/heritage sites. The only considerations mentioned in the EIA relate to possible impacts on visual aesthetics in the project area during construction phase as a result of clearing, site work, and heavy equipment and vehicles on the road. Yet it is expected these impacts will be restricted to the construction period of the project and mitigated through measures such as rejuvenation and landscaping of temporary project sites, muck disposal sites, etc. Further, the EIA report also mentions that the reservoir will be a positive visual feature, with some potential for recreation for tourists, thus contributing to preservation of natural and cultural heritage. (WAPCOS Limited, "Comprehensive Environmental Impact Assessment Study for Chamkharchhu-I Hydro Electric Project, Bhutan." Volume 1, EIA Report, January 2016.)

of hydropower projects are clear, well-defined, and quite robust. As mentioned above, the Environmental Assessment Act (2000) requires that an Environmental (and Social) Impact Assessment (EIA) be conducted for hydropower projects, which in turn is regulated by NEC. Obtaining ECs for social impacts entails clearances from various competent authorities, including the NLC for land acquisition. Likewise, a Notice of Consent is required from the household/individual affected by land acquisition before the NLC can issue clearance to proceed with land acquisition.

Additionally, the Land Act (2007) governs land acquisition, which is administered by the Land Acquisition Committee of the Dzongkhag. According to the Act, when land is required for a project, preference is to be given to land-for-land compensation, but the affected household can choose between land or cash compensation. However, when very small parcels of land (<0.01 acre, or <0.004 ha) need to be acquired, the affected household is compensated with cash alone. Compensation rates for land are determined by the Property Assessment and Valuation Agency (PAVA), but paid by the relevant agency acquiring the land, facilitated by the Land Acquisition Committee of the relevant Dzongkhag. While the PAVA rates are supposed to be updated periodically, the current rates were set back in 2009. As also pointed out in the Hydropower Sustainability Assessment for Mangdechhu, these rates are considered low given that the market value of land[19] has increased significantly since 2009. At present, Bhutan does not have any provisions to pay for land preparation of substituted land but requires that compensation be paid for any standing crops, trees, fruit trees, stone walls, huts, and houses. Because of the lack of compensation for the loss of production potential or support for land preparation, and limited availability of land of equal quality, some of those provided with land-for-land compensation have suffered a loss, according to the Hydropower Sustainability Assessment of Mangdechhu.

Almost all the laws and policies relating to hydropower development (and other development activities) make reference to cultural heritage and recommend actions to preserve it. For instance, the Land Act (2007) prohibits acquisition of land occupied by religious monuments. A lack of clear demarcations of heritage sites, however, makes it hard to fully assess the impact of hydropower projects on cultural heritage. Cognizant of this, the NLC has undertaken a project to map all the heritage sites of Bhutan, including the creation of buffer zones to limit the development impacts on the sites.

Public consultations are mandatory under the Environmental Assessment Act (2000), the Regulation for the Environmental Clearance of Projects (2001), the National Environment Protection Act (2007), and required by the EIA guidelines for hydropower projects.[20] Consultations, however, rely heavily on local authorities, thus limiting the space for citizen and civil society engagement.[21] Moreover, the current regulations do not have any specific requirements on the nature, mechanism, and

[19] In Bhutan, like in many other developing countries, there is no set methodology for the determination of market price, which is made even more difficult by the fact that the exact transaction price of land sale is not always reported fully. However, discussions with community members in Mangdechhu and with officials from the National Land Commission indicate that the price of land is at least 50 percent higher than the PAVA rates.

[20] The Regulation for the Environmental Clearance of Projects (2001) requires public consultation once the initial environmental screening is completed, as well as issuance of public notice on the availability of the Environmental Assessment Report.

[21] For instance, Article 31.1 (d) of the Regulation for the Environmental Clearance of Projects (2001) mentions: *The local authorities shall help concerned people express their views to the applicant. The local authorities may represent the community in negotiations with the applicant and shall do their best to ensure that the applicant has paid adequate attention to local concerns.*

mode of consultation, resulting in procedures that seem to differ significantly across projects. The Environmental Assessment Act (2000)[22] further requires that once the environmental clearance has been obtained, project-related information—including project description, measures for mitigating adverse impacts, and rationale for authorizing the project—be made available to the public.[23] However, the existing regulations and guidelines are largely silent on the modality for disclosure (that is, medium, location, language).

Finally, the current practice in hydropower projects is to put in place two grievance redressal mechanisms (GRMs) for community members or groups to raise issues and receive feedback. One mechanism relies on the standard government system for communication with communities, while the other mechanism involves a direct line of communication with the project staff. In Bhutan, the latter is ad hoc, since most projects do not have a formalized grievance mechanism for project-affected communities. In the case of the government mechanism, the line of communication goes from an individual or group at community level through the *Gup*, the elected representative at the *Gewog* level, to the Dzongkhag administration, which in turn contacts the relevant project authorities. The response from the project is then relayed to the community members/individuals through the above channel.

Early Planning: Similar to environmental impacts, social aspects are considered in the MCA for inclusion of hydropower projects in the pipeline (see Chapter 3). The social impacts focus on improved livelihood, such as better socioenvironmental benefits, employment benefits, access to power, and tourism possibilities. Resettlement and rehabilitation is only one of five social factors considered. In addition, a separate main criterion, representing 15 percent of the total score, is dedicated to Balanced Regional Development, which favors distributing the hydropower to regions currently less developed. The MCA process reaffirms the notion that the negative social impacts of hydropower in Bhutan are small because of the projects' small footprints and highlights the assumed positive impacts of large industrial development such as hydropower.

Impact Assessments: The guidelines for environmental assessment of hydropower projects envisage two types of social impact: (i) effects on land environment, and (ii) socioeconomic effects. Among these, a few are meant to be considered, including changes in land use, impacts of land acquisition, impacts on the local economy, the influx of laborers and its impact on local resources, impacts on vulnerable groups, and impacts on holy places and tourism (Table 4-10).

While covering the most important impacts, the EA Guidelines do not provide very clear guidance on the methodologies to be used for evaluating and predicting *social* impacts, nor do they provide criteria for defining impacts and area of impact, at least not to the same extent that they do for *environmental* impacts. Furthermore, where guidance is provided on suggested methodologies, an assessment of EIA reports reviewed indicates that the recommended methodologies are often not followed. Additionally, the Guidelines fail to systematically address other key areas of concern such as vulnerable groups living in the project area, livelihood impacts downstream, impact on cultural assets, effects on social and cultural cohesion, and opportunities for positive benefits to be derived from the power scheme.

[22] Likewise, the National Environment Protection Act (2007) establishes the right to be informed about the state of the environment and all activities that could potentially affect the environment.

[23] See Chapter IV, Article 28, of the Environmental Assessment Act (2000).

Table 4-10 Social impacts to be assessed according to Bhutan guidelines for environmental assessments

Land environment
• Changes in land use/cover and drainage pattern; • Immigration of laborers; • Changes in land quality including effects of waste disposal; • Impact of workforce on local resources; • Impact of induced infrastructure development.
Socioeconomic aspects
• Impact of land acquisition; • Impact on local economy; • Impact on human health; • Impact due to increase in traffic; • Impact on vulnerable groups; • Impact on holy places and tourism.

Table 4-11 Impacts beyond land requirements mentioned in EIAs

Project	Identified impacts beyond land requirements
Chamkharchhu HEP-I	*Negative impacts:* Dust, labor influx. *Positive impacts:* Income-generation opportunities (e.g., small service businesses, such as restaurants and small shops); access to electricity, access to health facilities through project hospital, and job opportunities thanks to increased access to electricity.
Mangdechhu	*Negative impacts:* Influx of migrant workers, interactions of workers with host communities, increased traffic, noise pollution, deterioration of village forests because of fuelwood use in camps. *Positive impacts:* possibilities for cash-generating activities; sale of farm products; improved flow of money, which boosts the local economy; improved roads; improved education and health facilities; new jobs.
Nikachhu	*Negative impacts:* Impact on visual aesthetics during construction, social and cultural instability, health risks and safety risks. *Positive impacts:* Opportunities for employment and businesses, new access roads.
Punatsangchhu-I	*Negative impacts:* displacement of families from their lands, homesteads, and economic activity; intermixing of native Bhutanese population with expatriate labor force, potentially giving rise to conflicts. *Positive impacts:* Availability of jobs for the locals, increased scope for nonproject activities for the locals, availability of electricity.

While EIAs assess the immediate impacts of land acquisition on livelihoods, assessments of the impacts of ancillary structures vary across the EIA reports (Table 4-11). For example, the EIA for Chamkharchhu I only assessed the impacts associated with the 46.32 ha of land required for reservoir submergence, while the total area required for various other project components like dam structure, powerhouse, and other equipment is 697.46 ha, and for about 82 km of new roads is 245.55 ha.[24] By contrast, the resettlement impacts specified for Nikachhu relate to the land requirements for the project as well as ancillary structures.[25] Downstream

[24] WAPCOS Limited, "Comprehensive Environmental Impact Assessment Study for Chamkharchhu-I Hydro Electric Project, Bhutan." Volume 1, EIA Report, January 2016.

[25] Druk Green Power Corporation Limited and Tangsibji Hydro Energy Limited (THyE). 2014. Environmental and Social Impact Assessment Report (ESIA) for Nikachhu Hydropower Project, Volume IV: Main Report (Part 1).

impacts of power projects are limited largely to environmental issues (e.g., flow regulation, riverine ecology, hydrological ecology) and very little, if any, consideration is given to livelihood impacts.

While all the EIA reports reviewed mention both the positive and negative impacts of the respective projects beyond land acquisition (employment and other livelihood opportunities related to the project, noise pollution, influx of laborers, waste water disposal, etc.), specific details about the scope and scale of these impacts/benefits are not always provided. Additionally, reports reviewed do not always provide details on the methodologies adopted for gathering baseline information nor the criteria used to determine the impacts of the project. Moreover, in the absence of any clear guidance on the definition of vulnerable groups, different projects have used this term differently and, accordingly, measures for minimizing risks and maximizing project benefits also vary.

Such weaknesses in the EIA reports, corroborated by the independent review that used the Hydropower Sustainability Assessment Protocol, make it difficult to ascertain *whether the current findings suggesting that hydropower projects do not have a significant social impact are the result of weaknesses in the EIA reports or merely reflect the true absence of major social impacts.*

Public Consultations: Every project's EIA report has a section on public consultations, including summaries of the issues raised during consultations. However, as current regulations do not have any specific requirements on the nature, mechanism, and mode of consultation, procedures adopted seem to differ significantly across projects. For instance, consultations on the MHEP were held primarily with the local government authorities in Trongsa, and the participation of project-affected households was minimal.[26] On the other hand, consultations on the NHPP were carried out at two levels—nationally and locally. Local-level consultations involved the Dzongkhag officials, Geog authorities, and one representative from each of the households in the Geog. Available documentation on the consultations does not indicate how the issues raised during these consultations were taken into consideration during the project design and implementation. To cite an example, in Chamkharchhu-I, local communities had raised concerns about the impact of muck disposal on irrigation channels, but neither the EIA nor the EMP have explicitly addressed this concern.

Communications and consultations are also required during project implementation. The Hydropower Sustainability Assessment for Mangdechhu mentions regular feedback and actions in response to community concerns are well-integrated, in a timely manner, leading to general community support for the project. A few complaints—such as poor drainage from construction camps, dust pollution, and inadequate support provisions following land acquisition—have been voiced, but the project is seeking ways to address them.

Because the existing regulations and guidelines are largely silent on the modality for disclosure, the ESIA as well as EMPs are generally all written in English, which presumably makes these documents inaccessible to the general public. While most of the hydropower projects maintain an official public website, these sites provide varying degrees of information on the project, the tender information, and other aspects.

[26] Two rounds of public consultations were held in September 2014. While approximately 50 percent of the participants in the first consultation were local community members, the second round of consultations did not include any local members nor project-affected families (though there were local government representatives and local authorities); see "Environment Impact Assessment" for Mangdechhu Hydropower Project, Chapter 11.

Recognizing the importance of having a project-specific GRM, some projects like the NHPP have also created a separate Grievance Redress Committee, comprising representatives from the THyE and DA, to receive and address complaints, and assigned a Grievance Redress Focal Person at the project office. Thus far, with the exception of a few complaints about the dust generated, vehicle traffic, the impact of blasting on housing, public safety, poor sanitation affecting water quality around labor camps, and improper management of waste disposal—issues that seem to be common across projects—there is widespread support for the hydropower projects and no major ongoing opposition motivated by project-related issues affecting the communities. However, *it cannot be determined from the current review if this reflects genuine support for the project or merely underscores the current GRM system is not very effective.*

Mitigation Measures: As mentioned above, the direct impacts of hydropower development on local communities, at least in terms of relocation and resettlement of people, have been minimal, if not completely absent. Despite this, the existing hydropower projects have taken a number of measures to provide direct livelihood support programs beyond compensation.

However, these livelihood support programs have been conceived and implemented differently across projects. For instance, in accordance with the Hydropower Development Policy, Punatsangchhu-I Hydroelectric Project Authority as well as NHPP have earmarked 10,000 units of free power for every acre of land that was acquired. Beyond this, the NHPP is also supporting a Community Development Plan that is being implemented by *Geogs.* Based on local demands and needs, specific activities in the plan include black topping of farm road, three agriculture market outlets, and skills development.

For the MHEP, the benefits to project-affected communities span across support for agriculture; water resources; cultural aspects; business opportunities; and public health. What is more, community members attest to a high level of satisfaction with the benefits promised and delivered. However, for all projects except Nikachhu, the EMP's section on socioeconomic impacts and development deal mainly with the impacts of land acquisition and the compensation for this, while the project's wider contribution to development is negotiated with the GNHC and the DA, and not included upfront in the EIAs, EMPs, or other management plans.

Construction and operation of hydropower facilities also have the potential to leverage supply chains for long-term community development and support local area development, including the creation of job opportunities for local communities (see Box 4-3 as an example of measures adopted for the Chaglla Hydroelectric Project in Peru to promote supply chains). The sector in Bhutan has yet to absorb local manpower, despite being beneficial to economic growth and poverty reduction in other ways. As already identified by the 11th Five-Year Plan, many of the new construction jobs have gone to foreign workers (over 22,000 foreign laborers in the hydropower construction sector). The Hydropower Development Policy (2008) has provisions for local employment and training opportunities to foster technology transfer and enhancement of skills among Bhutanese workers,[27] but the extent to which these provisions are being implemented is unclear. For instance, in the

[27] Specific provisions in the Hydropower Policy include: foreign companies allowed to bring in expatriate personnel in areas where there is a shortage of Bhutanese with requisite skills; developers required to provide employment to one member of each of the families displaced as a result of land acquisition; developer to submit a Human Resources Plan for implementation and O&M phase to the Ministry of Labour and Human Resources (MoLHR); at least 75 percent of the employees need to be Bhutanese during O&M phase; developer to implement a training program endorsed by MoLHR.

Box 4-3 Leveraging the Benefits from Hydropower Development: Experience from Peru

The 456 MW Chaglla HEP on the Huallaga River in Peru is financed by equity contributions from Odebrecht and loans from a number of development and commercial banks, including the Inter-American Development Bank (IDB), the Banco Nacional de Desenvolvimento Econômico e Social (BNDES), and COFIDE (a Development Finance Corporation).

The local population in the Huánuco region of northern Peru, between the Andes and the Amazon where the project is located, had high levels of illiteracy and poverty, and maintained traditional forms of livelihoods. To support local communities, Odebrecht Peru first conducted a study to understand the socioeconomic profile of the project area and subsequently carried out an awareness campaign to convey the basics of construction work in hydropower projects, targeted at the general public. Fliers, radio broadcasts, theater groups, illustrated booklets, and the like, were used to encourage local communities to apply for the *Creer* ("Believe") Peru program, an innovative professional training program aimed at improving the skills and employability of local communities in civil construction. The program included a *basic* module to prepare community members for construction work at the jobsite, and a *technical* module in areas related to civil construction, including carpentry, electrical work, masonry, welding, etc. Once certified, many of the participants were hired for Odebrecht construction projects, and the skills they acquired were universal, thus opening up employment opportunities for them long after the construction phase of the Chaglla project had been completed.

Source: International Hydropower Association

Additionally, to support the local supply chain development, Odebrecht also introduced a Business Network Program. The objective of the program was to bring together farmers from the region and local merchants to allow local communities to benefit from the project's preferred procurement of goods, services, and agricultural products from inside the project 's influence zone. A review of local supplier capacities for supplying vegetables, coffee, dairy products, fish, and the like, was conducted. Next, the project identified 18 agricultural producer cooperatives and proceeded to support them with an agricultural technical assistance program and the establishment of an agrobusiness network.

Source: World Bank.

ESIA for NHPP, a provision has been created for the contractor to reserve 30 employment positions for local community members, out of an expected total of 2,000 workers for the project.[28]

Institutions and Capacity: The regulatory responsibilities for managing the social impacts of hydropower lie with NEC. The capacity constraints due to limited manpower and

[28] Druk Green Power Corporation Limited and Tangsibji Hydro Energy Limited (THyE). 2014. Environmental and Social Impact Assessment Report (ESIA) for Nikachhu Hydropower Project, Volume IV: Main Report (Part 1), p. 220.

resources at NEC (Appendix C) are, therefore, affecting the quality assurance for assessment and mitigation of social impacts. During the stakeholder interviews, one of the reasons given for the inadequate attention given to social issues in hydropower projects was insufficient capacity in the current institutional setup. The general capacity constraint is exacerbated by NEC not having dedicated personnel with expertise in social development. The GNHC has more staff focused on social development and is responsible for addressing social and development issues in the respective Dzongkhags. However, since the GNHC's role is to facilitate the participatory planning process for all sectors, it leaves them with very little time to oversee hydropower projects. Within project authorities, generally there is a designated *environmental* specialist but none to fulfill the *social* management role.

Key issues

In summary, though Bhutan's natural features—especially its steep valleys and deep gorges—render the direct impacts on people and property relatively limited compared with many other countries, the assessment of current management practices has identified a number of gaps that need to be addressed to effectively manage the social impacts. In particular, *the EIA process on social aspects, including the guidelines to fully assess the impacts of hydropower development on livelihoods, needs to be strengthened.* This is especially important in view of the strong focus in the planning process on improving livelihoods, primarily through enhanced socioeconomic benefits and balanced geographical development. As noted, while all the EIA reports reviewed mention both the positive and negative impacts of the respective projects beyond land acquisition, specific details on the scope and scale of these impacts and benefits are not always provided. There is a need, therefore, to strengthen the EIA guidelines related to social assessments. Similarly, *the capacity of the regulatory bodies, including NEC, to oversee social issues related to hydropower development has to be enhanced.*

Additionally, *the compensation rates for land acquisition should be updated.* As mentioned in the application of the Protocol reported for MHEP (Appendix D), current rates are low, considering that the market value of land has increased significantly since 2009, when the rates were last set. Moreover, compensation for land acquisition should be supplemented with support for preparation of the new land provided as compensation.

Clearer guidelines on consultation procedures and modes of information disclosure are also needed. The current regulations do not have any specific requirements on the nature, mechanism, and mode of consultation, and consequently, the procedures adopted seem to differ significantly across projects. Similarly, existing regulations and guidelines are largely silent on the modality for disclosure (that is, medium, location, and language), which also adversely affects compliance. The existing practice of relying on local government for grievance redressal is insufficient to address the possible volume of complaints arising from hydropower development. There is a need for project-specific GRMs, such as the one established for NHPP, which involves representatives from the THyE and DA, including a Grievance Redress Focal Person at the project office.

4.3 Impacts of transmission lines

Relevance

Many of the issues associated with transmission lines are similar to those found in road projects. These include fragmentation of habitats when the Right of Way (RoW) traverses forested areas, and the impact of access roads on soil erosion, hydrology, and water balances. Restrictions on land use, especially in the

RoW of transmission lines, devaluation of surrounding property due to the presence of transmission lines, and increased deforestation resulting from the provision of access to remote areas, are also major issues related to the construction of transmission lines. Transmission lines can also spark forest fires, and another important and usually highly controversial effect of transmission lines is bird mortality. Electrocutions are nowadays rare though, as modern transmission lines have greater insulator lengths and distances between metal structures and conductors.

Additionally, the cumulative impacts from hydropower projects and their complementary infrastructure such as transmission lines can have a significant impact on tourism areas—either directly, for instance, by affecting river flows used for rafting, or indirectly, by undermining the scenic value of landscapes that embed cultural and natural sites or trekking paths. The scenic and cultural values of the Douro Valley in Portugal have been at the center of a controversy about hydropower development and the necessary transmission line network, and maintaining the valley's UNESCO Global Heritage Site status (Box 4-4).

Current impacts in Bhutan

The National Transmission Grid Master Plan for Bhutan was prepared by the Central Electricity Authority of the government of India for evacuation of surplus power from the 10,000 MW of joint RGoB-GoI hydropower projects approved in June 2012. A geographical

Box 4-4 Impacts of Transmission Lines in the Alto Douro Wine Region

Traditional landholders have been producing wine in the Alto Douro region for some 2,000 years. Since the 18th century, the region's main product, port wine, has been world-famous for its quality. This long tradition of viticulture has produced a cultural landscape of outstanding beauty that reflects its technological, social, and economic evolution. The Alto Douro region was placed on the World Heritage List in 2001, as a Cultural Landscape, encompassing 24,600 hectares and a buffer zone of 225,400 hectares.

In 2008, a National Plan for the concession of 10 hydroelectric projects (HEPs) with high potential was approved. The first project, the Foz Tua Hydroelectric Project, was approved in 2009. Even though the dam and reservoir themselves are sited outside the boundaries of the heritage site, the transmission lines would traverse the site; other lines have already been built. The EIA had a short reference to the transmission lines (stating that they would not affect important bird areas). Opponents of the Foz Tua project (wine growers, NGOs, tourism associations) lodged a complaint against this project with the International Council of Monuments (ICOMOS). In 2012, the World Heritage Committee approved a decision urging the government of Portugal to stop the works. The Committee's main argument was that the direct impact on the World Heritage site would primarily be a consequence of the proposed transmission lines—the resulting physical loss of part of the landscape would change the way people would experience the landscape, as those lines would affect the pattern, context, and setting of this World Heritage site.

Source: World Bank.

analysis of the footprint of existing and planned transmission lines on protected areas and biological corridors is presented in Table 4-12 and Figure 4-3. Transmission lines largely avoid protected areas and instead traverse biological corridors. Moreover, parallel lines have been planned to minimize impacts.

Table 4-12 Impact of existing and planned transmission lines on protected areas and corridors[a]

Indicator (cumulative)	Existing transmission network	+ Transmission network under construction
Transmission lines through protected areas network (km)	120.03	201.34
Affected protected areas network (km^2)	4.27	9.58
Affected protected areas network (%)	0.02	0.04

Source: Bank analysis.

Note: a. See Appendix B for more details.

The EIAs for transmission lines reviewed for this study identified the following major issues: loss of private land, the influx of migrant workers, possible conflicts with local communities, and other construction-related effects such as an increase in traffic and noise pollution, and impacts on forests due to the use of fuelwood in workers' camps. Others adverse effects—those resulting from land acquisition, the risk of electrocution, exposure to electromagnetic fields, and the impact on the country's cultural heritage—were considered minimal (Table 4-13).

The EIAs do not include a comprehensive analysis of the impacts of transmission lines on biodiversity, habitats (fragmentation), land use (restrictions, especially related to the RoW

Figure 4-3 Protected areas and corridors affected by existing and planned transmission line network

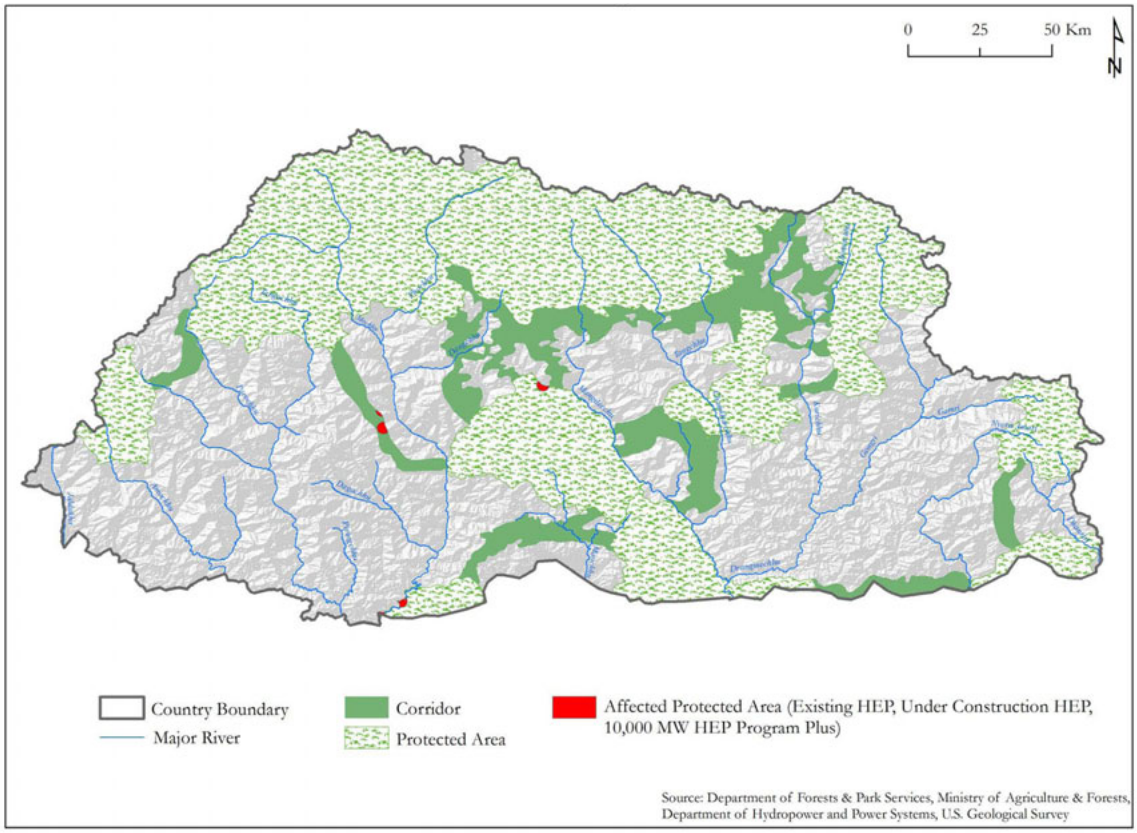


Table 4-13 Impacts of transmission lines mentioned in EIAs

Transmission line	Impacts identified/discussed
132 kV D/C power transmission line from Phuntshothang to Motanga under Samdrupjongkhar Dzongkhag	• 21.5 km of RoW currently under different uses, including GRF, biological corridor connecting Jomotshakha Wildlife Sanctuary and Royal Manas national park, and private owned agricultural land; • No impact on individual houses, religious sites, water supply sources, and other infrastructure; • 8 landowners will lose their land for tower construction, and RoW will pass over land of 4 households, including an orange orchard, agricultural land, and fallow land; • Influx of foreign workers during construction could lead to social instability, increased pressure on local resources (e.g., housing, infrastructure services, fossil fuel consumption), loss of vegetation, and spread of communicable diseases; safety concerns regarding work sites; • Risk of electrocution and other accidents during construction and maintenance works, risk of fire by flashover, risk of birds being electrocuted of birds; aesthetic impact.
400 kV double circuit power transmission line for Punatsangchhu II	• 66 km of RoW with total estimated land area of 837.76 acres and tower bases requiring 24.15 acres of land, of which 3 acres (12.4%) is privately held; 20 households affected by construction of tower bases and 90 households by the RoW in 3 Dzongkhags; • Restricted use of land and loss of crops; • Transmission line will not traverse any religious, cultural heritage, or archeologically important sites ; • Construction-related impacts including disturbances to flora and fauna, traffic hazards, noise pollution, occupational safety, and waste disposal; • Impacts of electromagnetic fields during operation.

of transmission lines), landscape, and property values. Furthermore, other important and usually highly controversial adverse effects—such as the possibility of sparking forest fires, and bird mortality due to collisions with man-made structures located on their flight paths—are not adequately discussed in the EIAs either.

Despite the limited identification of E&S impacts of transmission lines in the EIAs, there are indications that those impacts could actually be significant. For example, the transmission line to be built for MHEP will have a total length of 80 km, a 52 meters wide RoW, and pass through approximately 55 km of government-owned forest land and 22 km of protected area. The transmission line is expected to affect the Royal Manas National Park and the Jigme Singye Wangchuck National Park, as well as a biological corridor connecting Royal Manas and the Phipsoo Wildlife Sanctuary and the corridor connecting the Jigme Singye Wangchuk National Park and the Thrumshingla National Park. Consultations with different stakeholders, including BPC, the NLC, and the DHPS also indicated an increasing concern over issues of land acquisition, particularly in the RoW of transmission lines, but the EIAs only discuss land issues in the context of land area required for the construction of tower pads. The RoW aspect is particularly important given concerns about property devaluation in areas surrounding transmission lines.

Conflicts involving transmission lines and scenic areas have already emerged in Bhutan. For instance, two transmission lines were removed because they were blocking a scenic view for the Dochula pass and the Jomolhari trek. The analysis in some EIAs classifies these impacts as "*temporary and after few years the tower will be hardly visible due to vegetation cover (low height bushes) throughout the RoW.*"

Current management practices

In Bhutan, BPC is responsible for the transmission and distribution of electricity, and the Bhutan Electricity Authority (BEA) is the designated electricity regulator. BPS has been entrusted with the preparation of EIAs and has been using its in-house resources to conduct the E&S impact assessments of transmission lines. Similarly, BPC implements its EMP through its contractors.

Besides the E&S rules and regulations, Bhutan has endorsed a separate Environmental Assessment Guide for Transmission Lines (2012). The EIA guideline for transmission lines mentions the same procedures for assessing those impacts as it does for hydropower projects, namely, screening to determine whether an EIA is required, scoping to establish the E&S priorities, developing the ToR, generating baseline data, conducting an impact assessment, defining measures to mitigate the impacts identified, and preparing an Environmental Management Plan. The EIA guideline for transmission lines further specifies some impacts that must be addressed—those related to land acquisition; slope destabilization due to construction works; aesthetic impacts; fugitive emissions; impacts on biodiversity, and surface and ground water resources; risks and hazards associated with transmission lines; potential exposure to electromagnetic fields; and potential occupational health and safety issues.

Based on the impacts identified, the Environmental Mitigation and Management Plans for transmission lines reviewed also included a detailed set of mitigation measures (Table 4-14). BPC and NEC considered the initial draft EIA for Mangdechhu inadequate and demanded it be revised. This shows that Bhutan gives serious consideration and scrutiny to the E&S impacts of transmission lines. Similarly, a transmission line for Mangdechhu was rerouted to avoid a landslip risk area.

Notwithstanding these measures, the current regulatory framework for transmission lines does not require a scientific assessment of impacts on landscape in or near potential tourism areas (trekking paths, for instance), property values in surrounding areas, habitat (fragmentation), and biodiversity. Mitigation plans mainly focus on minimizing the felling of trees, especially of valuable species, and replanting the protected species affected; avoiding electrocution; and mitigating construction-related impacts. By contrast, measures to lower the risk of forest fires, compensate for usage rights along the RoW of transmission lines, and reduce the aesthetic impacts require strengthening.

Key issues

The existing regulations and practices for managing the E&S impacts of transmission lines are strong in Bhutan and, in several instances, follow international good practices. The likely impact of transmission lines is also considered to be minimal due to the country's mountainous topography (requiring minimal clearing of ground vegetation) and the possibility of construction-related impacts being abated over time through natural regeneration. However, in the absence of studies and monitoring reports on the broader impacts of transmission lines, it is difficult to determine the effectiveness of the existing guidelines and specific mitigation measures mentioned in the EIAs/EMPs. Issues of noncompliance have already been noted in relation to the construction of transmission line for MHEP, where two access roads were constructed without obtaining prior environmental clearances. There is, thus, a need to develop sufficient and appropriate capacity at the BPC and NEC for effective implementation of the mitigation measures developed and for monitoring compliance with existing rules and regulations.

Table 4-14 Mitigation measures included in the EMPs for select transmission line projects

Transmission line	Key mitigation measures included in the EMP
132 KV D/C Power Transmission Line from Phuntshothang to Motanga under Samdrupjongkhar Dzongkhag	• Cash compensation for private land acquired for tower footing, temporary use of land for construction of labor camps restored and revegetated, and direct damage to fruit trees and standing crops compensated during project implementation; • Medical checkups of laborers; minimal conflicts with local communities and minimal pressure on local resources expected; • Visual impacts addressed in the long term through increase in vegetation cover throughout the RoW; • Occupational health and safety issues addressed by abiding with the Regulation on Occupational Health, Safety and Welfare (2012); contractors to provide personal protective equipment (helmets, safety goggles, safety harness, etc.) to workers; • Reduce the impact of electromagnetic fields by avoiding settlements and sensitive receptors while selecting the RoW alignment; • Sporadic clearing of trees in the RoW with the option for trimming wherever possible, and mandatory planting of twice the number of trees felled during construction; • Awareness campaigns to inform workers about forest rules and regulations; • Installation of visibility-enhancement objects such as marker balls, jumper wires on all electrical equipment, bird diverters or deterrents (e.g., silhouettes of predators) to repel birds so as to avoid their electrocution.
400 kV Double Circuit Power Transmission Line for Punatsangchhu-II	• Free and fair compensation to landowners in accordance with the provisions of the Land Act of Bhutan; • Replacement value for crops/plantation and other assets; • Identify contracting/employment opportunities for people whose land will be affected; • Include provisions in contract (with the contractors) to ensure that construction workers do not cause disturbances, otherwise adversely affect nearby households or cause them any inconveniences; Bhutan's regulations on occupational health and safety are observed; • Map all cultural sites in a location before construction begins and ensure that those cultural and heritage sites are not affected; • Avoid mature trees while clearing vegetation and communicate your intention to cut trees to the respective Forestry Division and other authorities, prior to doing so; • Minimize safety risks to the general public by putting up construction and warning signs, sensitizing local communities to potential risks and hazards, and placing anticlimbing devices on all faces of towers. • Install visibility-enhancement objects (marker balls, bird deterrents, diverters) to avoid avian collision; • Reduce exposure to electromagnetic fields by maintaining EMF levels below the reference levels developed by the International Commission on Non-Ionizing Radiation Protection; • Develop transmission line disaster management plan prior to commissioning of transmission line.

Note: EMP = Environmental Management Plan; RoW = Right of Way.

In addition, more guidance is needed on how to conduct a comprehensive assessment of transmission lines that also considers the impacts on landscapes, the value of surrounding property, cultural heritage, biodiversity, and the livelihoods of local communities. Given the increasing concerns over devaluation of property close to transmission lines, Bhutan should also consider introducing provisions for easement between BPC and the landowner—where the usage rights over the strip of land that falls under the RoW of the power line are paid to the landowner by the BPC, while the landowner maintains ownership of that parcel or strip of land.

Furthermore, the Tourism Council of Bhutan (TCB) does not appear to actively participate

in the EIA clearance process. If it did, this could help avoid undesirable impacts before transmission lines are built rather than require the relocation of lines. Addressing both the need to strengthen impact assessment at the landscape level and the need for improved coordination with TCB would help improve the management of these impacts.

4.4 Construction-related environmental and social impacts

Relevance

Impacts during the construction phase can be both temporary and permanent, and relate to the installation of infrastructure, earthworks and spoil management, vegetation clearance, traffic, and the relevant discharges from these activities. The presence of large workforces in remote areas increases pressure on fragile ecosystems by boosting demand for timber for cooking, illegal hunting, and poaching. Camps can also cause pollution when disposing of wastewater and solid wastes. The influx of workers can lead to the spread of communicable diseases and affect the social dynamics of local communities. Therefore, steps must be taken to ensure that (i) the quality of the workers' camps is compliant with national laws and regulations, and (ii) workers have all the amenities and facilities they need to perform their job fully, without putting pressure on local communities.

Bhutan is a small country with a limited road network and a small population. A hydropower project involves substantial transportation of goods and the influx of thousands of foreign laborers, and thus can have a large impact on a small town or village during construction, usually lasting 5–7 years. Bhutan's steep mountainous slopes also pose challenges for infrastructure construction—mainly the risk of erosion and landslides, and the limited space available for disposal of muck (from underground excavation) and other waste. To ensure environmentally sustainable development of hydropower, it is important to prevent muck and eroded material from being indiscriminately deposited on hill slopes, damaging forests and ultimately adding to the silt load. Because of the large planned expansion of hydropower in a short period of time, with many projects to be constructed simultaneously over the next 10 years, proper management of *temporary* impacts is crucial.

As hydropower development rapidly expands in Bhutan, it will also be critical that the project developers and contractors put in place stringent measures to ensure safe construction practices, particularly given the specific hazardous working conditions inherent in the construction of large infrastructure (involving underground works and/or working at heights). Appropriate sewage treatment and management approaches should be designed and implemented, taking into account the geology of the region.

Current impacts and management practices in Bhutan

The management of construction impacts is perhaps the issue receiving the most attention in EIAs. However, most of the proposed mitigation measures are of a generic nature, with little or no tailoring to specific project sites. The lack of a systematic approach to construction management issues, further exacerbated by inadequate compliance frameworks, has resulted in impacts on the environment and neighboring communities. The Hydropower Sustainability Assessment of MHEP also identified the issue: the impacts from ancillary infrastructure, including dust, noise, and other risks from access roads, were not assessed. The lack of site-specific E&S management plans makes it difficult to monitor these impacts as well as compliance with the EMP.

Similar conclusions can be drawn for the social impacts of construction work. In

Chamkharchhu-I, it is expected that about 800 workers and technical staff will be working in the project area for approximately nine years. Discussions on the effects of such an influx of workers, as mentioned in the EIA, are limited to problems of sewage disposal, solid waste management, indiscriminate fishing, and health risks. Accordingly, the mitigation measures proposed include the development of a waste disposal plan, the setting up of appropriate units for the treatment of domestic sewage before its disposal into the river,[29] and free fuel provision to the laborers. The EIAs for other projects follow suit in that the impacts from the influx of laborers are recognized but details on the scope, nature, and extent of those impacts are discussed only in very general terms, and the mitigation measures suggested are also very general.[30] The impacts of a big influx of workers at such construction sites typically go beyond the typical camp management issues. To give just one example, the carrying capacity of Trongsa Town has reached the point of visitor saturation as a result of the Mangdechhu hydropower project: incoming visitors have a hard time finding accommodation, in spite of the area having six hotels.[31] Even though the MHEP is constructing its own accommodation facilities, the nearby construction of the NHPP has led to an even greater influx of workers, which can significantly affect other sectors such as tourism as well.

Key issues

Codes of Practice, and health and safety performance standards for good engineering during construction should be developed to minimize the impacts of construction and workers' camps. The development of Codes of Practice for E&S health and safety would simplify the EIAs for future projects by concentrating studies on the most relevant issues rather than on impacts that can be managed through good engineering practices. Most EIAs so far include mitigation measures for the management of construction, mainly labor camp management (controlling dust, noise, muck disposal, etc.). Most of these mitigation measures are identical across EIAs. Therefore, the adoption of a comprehensive set of environmental specifications for construction in Bhutan's hydropower would greatly simplify the EIAs by eliminating the need to repeat these measures in each EIA. EIAs could instead focus on issues such as the impacts on biodiversity and landscape, as well as cumulative impacts (in the case of cascade development). Moreover, the Codes of Practice mentioned above

[29] Though the EMP mentions a waste disposal plant and a wastewater treatment facility, the EIA report also points out that "*due to perennial nature of river Chamkharchhu, it maintains sufficient flow throughout the year which is sufficient to dilute the treated sewage from residential colonies. Therefore, as mentioned earlier, no adverse impacts on water quality are anticipated due to discharge of sewage from laborer camps or project colonies.*" WAPCOS Limited, "Comprehensive Environmental Impact Assessment Study for Chamkharchhu-I Hydro Electric Project, Bhutan." Volume 1, EIA Report, January 2016. WAPCOS Limited, "Comprehensive Environmental Impact Assessment Study for Chamkharchhu-I Hydro Electric Project, Bhutan." Volume II, EMP Report, January 2016.

[30] For example, the EIA for Punatsangchhu-I reads: "*It is felt that construction activities would be invariably undertaken by expatriate Contractors, most likely from India. Construction activities, it is predicated would be semi-mechanized. It is anticipated that most of the labor force, would be from India. A number of marginal activities and jobs would also be available to the local Bhutanese during construction phase. Marginal jobs such as those of unskilled labor, drivers, cooks, peripheral shops, peons and messengers etc. would open up for the locals. However, such opportunities would be limited. As it is evident from the experience of Tala hydroelectric project, it is predicted that the expatriate contractors will provide living space, kitchens, lavatory facilities etc. for the project labor force. Besides, the workload would be tremendous, and that the labor force would seldom find time and energy to interact with the local Bhutanese. . . . It is however, felt, that there may not be much cultural friction as interaction would be limited.*"

[31] Druk Green Power Corporation Limited and Tangsibji Hydro Energy Limited (THyE). 2014. Environmental and Social Impact Assessment Report (ESIA) for Nikachhu Hydropower Project, Volume IV: Main Report (Part 1).

Box 4-5 Different Approaches to Benefit Sharing

Project design and operations: Benefits through flexible infrastructure and integrated resources management, for example, multipurpose hydropower projects with different features such as flood control, irrigation, water supply, and water quality improvements can help provide a range of benefits to local populations, beyond access to electricity.

Ancillary investments: Physical infrastructure such as roads, bridges, and other project-related facilities; by investing in social infrastructure (e.g., schools, health facilities; community programs aimed at job creation, livestock production, income-generating activities, capacity building and training; and watershed protection investments, such as catchment treatment, erosion management, afforestation), among others, hydropower projects can provide support to local development, beyond providing compensation for the losses.

Direct payments/transfers: Legally binding transfers (e.g., royalties, taxes, development funds, preferential rates, and revenue sharing) are also increasingly being used to share project benefits with local communities. For instance, in the case of Nepal, the Chilime Hydropower Project allocated 10 percent equity to residents of the Rasuwa District. Two commercial banks provided on-the-spot loans (80% required capital). While the project was expecting to sell 960,000 shares to the project-affected population, it was oversubscribed 1.6 times.

Policies, institutions, and regulatory framework: Legally binding mechanisms (laws, acts, concessions, treaties) for distributing benefits can take various forms. For example, in Colombia, the legal framework requires financing of development initiatives with contributions from hydropower companies. In particular, Law 56 (1981) and Law 99 (1993) requires taxes, fees, and transfers from power generation companies be spent on local and regional administrations.

should include preparation of site-specific Environmental and Social Management Plans prior to the initiation of any construction activity at any site.

4.5 Beyond impacts to benefit sharing

Relevance

Benefit sharing refers to a framework for governments and developers to maximize and distribute benefits across stakeholders, beyond compensating the affected households for the negative impacts of hydropower development on their livelihoods and well-being. Benefit-sharing arrangements do not only accelerate the achievement of poverty reduction goals, but also help create social acceptance for large infrastructure projects that could otherwise be socially disruptive (see Box 4-5 for different types of benefit-sharing arrangements).

Current management practices in Bhutan

Benefit-sharing mechanisms in Bhutan are provisioned through the Hydropower Policy and include measures such as "royalty energy" free of cost from the total electricity generated. The volume of royalty energy is set at 15 percent of the electricity output from DGPC-operated, export-oriented hydropower projects. The royalty energy is provided to BPC at a discounted price of Nu 0.30/kWh (compared with the average export price of Nu 1.8/kWh) for supplying domestic consumers.[32] The provision of royalty energy supports RGoB in prioritizing rural electrification as a means of equitably distributing the benefits of Bhutan's hydropower resources, especially in support of the Master Plan for Rural Electrification that aims to achieve 100 percent electrification by 2020.[33]

In 2013, the RGoB decided to use the full annual average royalty energy volume of 1,049 GWh, amounting to Nu 1,458 million valued at the approved domestic generation tariff of Nu 1.39/kWh, to provide subsidies to low-voltage and

[32] Any energy purchase above 15 percent of the power output of DGPC has to be purchased by BPC at Nu 1.2/kWh.

[33] Asian Development Bank, "Bhutan: Energy Sector," Evaluation Study, Reference No. SAP BHU 2010–21, August 2010.

Table 4-15 Expected power generation and subsidy allocations

	2013/14	2014/15	2015/16
Expected volume of royalty energy (GWh)	1,043	1,048	1,057
Average volume of royalty energy (13/14–15/16)			1,049
Allocation of subsidies (Nu, millions)			
Low-voltage customers	1,271.704	1,271.704	1,271.704
Medium-voltage customers	186.296	186.296	186.296
High-voltage customers	0	0	0
Total	1,458	1,458	1,458

Source: Bhutan Electricity Authority, "Druk Green Power Corporation Limited Tariff Review Report," October 2013.

medium-voltage consumers.[34] The expected royalty energy volume, based on the expected power generated by DGPC, and the total subsidy allocation to various customer groups are presented in Table 4-15.

There is also a provision for a Renewable Energy Development Fund, which can be important for initiating development projects for the benefit of local affected communities. In accordance with the Hydropower Policy, part of the up-front premium deposited by the developer is to be allocated to the Renewable Energy Development Fund to be used for project development activities. The latter can include preparation of project profiles and reports, site investigation and studies, processing of clearances, and acquisition of land, but also promotion of projects, including payments for environment services such as upstream catchment protection, and renewable energy initiatives. Lastly, revenues from the hydropower sector go into the general coffers of the government and help support economic development and poverty reduction programs. Thus, while the sector has not supported specific benefit-sharing arrangements targeted at affected communities, it has definitely provided extensive benefits to the country.

[34] Bhutan Electricity Authority, "Druk Green Power Corporation Limited Tariff Review Report," October 2013. Available at http://www.bea.gov.bt/wp-content/uploads/2013/11/DGPC-tariff-review-report-2013.pdf

Key issues

The current benefit-sharing arrangements have a clear potential to contribute to economic development and poverty reduction in the country. Since these financial benefits are mainly accruing to the public sector, there is no need for additional benefit-sharing arrangements. What is critical is that the revenues from hydropower be used for broader economic gains and diversification; thus, national and local area development plans should be better aligned to strengthen benefit-sharing mechanisms and generate even greater support for hydropower development. Similarly, clarity on the scope and implementation modalities of the Renewable Energy Development Fund, being considered by the Department of Renewable Energy, will also enhance the management of E&S outcomes of hydropower development in Bhutan.

4.6 Beyond impacts to sustainability

Relevance

Bhutan is highly vulnerable to the adverse impacts of climate change due to the fragile mountainous ecosystem. Climate change and hydropower are inextricably linked. Hydropower as a clean, renewable source of energy has the potential to contribute to climate change mitigation. Alteration to river flow patterns induced by climate change can affect hydropower generation. The likely impacts of climate change on future hydropower generation

were assessed in 2009.[35] Though only a few global climate model projections were used, the study indicated only modest impacts up to 2050 since a possible reduction in precipitation would likely be compensated by increased melt from glaciers. Beyond 2050, there is a risk that river flow and power production may significantly decline because of diminishing glaciers, which would no longer make up for the decrease in precipitation.

Bhutan's location, climate, and topography make the country prone to a range of hydrometeorological hazards, including GLOFs, flash floods, and landslides, which can affect hydropower facilities. Since 2002, a number of flash floods and landslides have occurred in the country.[36] In particular, natural dam formation and dam bursts that could release huge volumes of water pose a major risk to hydropower plants. Again, climate change is an important factor that may increase the hazard of extreme hydrometeorological events.

The efficiency and sustainability of hydropower plants can be impaired by excessive sediment in the water. When abrasive sediment particles, in high concentrations, are transported into the flow passage of the power generation units, they can severely damage the equipment, reducing the availability of the plant. Sediment inflow can also reduce the capacity of reservoirs, which in turn leads to depletion of peaking capacity and adverse effects on the intake weir that controls sediment entry. Climate change can further increase erosion and sedimentation. *Indirect* land disturbances due to changed river flows caused by climate change can add to the erosion that results from *direct* land disturbance—due to road and construction works or to reservoir shoreline erosion (caused by fluctuating water level). Sediment management also relates to the need to maintain transport of sediment, including nutrients, for downstream areas.

Current impacts and management practices in Bhutan

Current climate change impacts on potential hydropower generation are likely to be small and, according to the 2009 study, will remain modest up to 2050. From an economic point of view, the hydropower projects are, thus, not vulnerable as the projects are normally paid off in about 15 years, and generate a very good economic return for the country for the period up to 2050. Even with reduced power production after 2050, the plants are likely to provide significant surplus because of the relatively low O&M costs of hydropower. The 2009 study, however, showed that impacts might be different for different river basins, especially beyond 2050. The 2004 Hydropower Master Plan did not assess how climate change may affect the different hydropower projects in the future. It is relatively simple to conduct such a sensitivity analysis to test the potential future vulnerabilities of the different proposed projects and doing so could improve the sustained production in the long term—by choosing the projects with the lowest risk of being negatively affected by climate change.

The Department of Hydro-Met Services (DHMS), under the MOEA, is responsible for hydrological and meteorological data gathering. It also serves as the technical agency responsible for providing early warning of hydrometeorological hazards and has an operational GLOF early warning system in the Punakha-Wangdi valley. The recent World Bank report concluded that despite the frequency of natural disasters and the climatic risks Bhutan faces, the information basis for assessing such risks is currently weak and needs to be strengthened. It further concluded that the DHMS needs significant institutional capacity

[35] Climate change impacts on the flow regimes of rivers in Bhutan and possible consequences for hydropower development, Norwegian Water Resources and Energy Directorate (NVE), 2011.

[36] Modernizing Weather, Water, and Climate Services: A Road Map for Bhutan, World Bank Group, May 2015.

strengthening to provide essential services for planning and disaster management.

Abrasion of underwater equipment due to excessive sediment in the water has been identified as a problem in the Chukha, Tala, Basochu L/S, and Basochu U/S hydropower plants, that is, in four of the country's six existing plants.[37] The designs of existing desilting chambers, which are predominantly of the hopper type, have been found to be inadequate in dealing with the inflow of sediment (leading to heavy sediment deposits). The government has plans to modify the design of planned desilting chambers to manage this problem better in the future. In addition, DGPC has taken measures to improve the O&M of the turbine runners affected by abrasion at existing plants, to minimize the losses due to reduced efficiency and the costs of replacement. A subsidiary employing 85 Bhutanese workers has been established in Jigmeling, in collaboration with an international turbine manufacturer, to repair and recover turbine runners.

Upstream sediment management has also been suggested as a way to reduce sediment inflow into the facilities, though at present, there appears to be limited coordination between DHPS and DFPS to implement watershed management and protection measures to reduce the inflow of sediment. EIAs and EMPs of hydropower projects typically include Catchment Management Plans to manage the impacts on water flows; these plans can also address sediment issues. However, there is a lack of clarity on the institutional responsibility for supporting and monitoring the development of such plans. The provision of the 1 percent royalty energy for integrated catchment area management will help support activities to reduce sediment, provided investments are targeted at activities and locations for this specific purpose.

Key issues

Disaster management, climate change management, and sediment management are not directly related to managing the E&S impacts of hydropower. However, they are examples of cross-sectoral planning and environmental management that are essential for the sustainability of hydropower in Bhutan. The lack of coordination between ministries and departments that are important for hydropower development, and the limited capacity of these, are key in making hydropower more efficient and resilient, thus generating sustained revenues for the RGoB.

[37] Visit of Sediment Management Specialist at Druk Green (www.drukgreen.bt).

Chapter 5
Discussion and Conclusions

There are many reasons to develop hydropower in Bhutan. The RGoB is well aware of the importance of hydropower for its economic growth. Revenues from hydropower, from the 1,606 MW developed at Chukha, Tala, Kurichhu, Basochhu, and Dagachhu, are already a significant source of funding for the state. Hydropower contributes significantly to the country's GDP, and since Bhutan is still running a fiscal deficit,[38] any decrease in revenues from hydropower means a reduction in the resources available for other sectors covered by the national budget. Any delay in development of its remaining hydropower potential is therefore seen as a delay in balancing the budget and becoming independent of donor support, as well as a delay in building prosperity and improving the livelihoods of the Bhutanese people.

Ongoing construction of new hydropower (Mangdechhu, Punatsangchhu-I, and Punatsangchhu-II) has boosted GDP growth through an inflow of capital and foreign workers. It has provided local businesses with opportunities in remote areas, where prospects are otherwise limited. Local districts in Bhutan have therefore actively sought to have hydropower projects developed in their area to create potential for local development and prosperity. The GoI, keen on clean and cheap power, has rapidly increased its demand for hydropower from Bhutan. India's large parastatal hydropower companies, such as SJVN, THDC, and NHPC, see Bhutan's hydropower potential as an opportunity to increase their market share in a difficult regional market. The interest from India in Bhutanese hydropower comes with associated bilateral aid, access to Indian commercial financing, and transfer of technical expertise that generates benefits for Bhutan beyond future revenues from hydropower.

The RGoB therefore focuses on using the country's immense water resources and the potential energy generated as efficiently as possible. It seeks to develop the most economically promising sites, that is, those with a strong interest from the buyer, as these will generate the highest returns for Bhutan in the future.

The pressure to quickly scale up hydropower has led to significant technical capacity development in Bhutan. Hydropower

[38] Bhutan Development update, The World Bank, April 2015.

development is seen as synonymous with industrial development and its planning is situated within the MoEA. The national hydropower utility, DGPC, which operates the hydropower plants, is fully owned by the MoF via DHI.

Today, DGPC is the largest company under DHI, with close to 1,800 employees. It retains 10 percent of the profit after tax from the operations of existing hydropower plants, which it has used to build its capacity and to explore and develop new hydropower projects through the PPP and JV models. The operational staff at the Chukha and Tala plants, mainly Indian in the beginning, have now been replaced with Bhutanese employees. Bhutanese managers and workers are gradually transferring their experience gained from developing and operating existing hydropower plants to the new hydropower projects under preparation and development, as well as to the new staff entering the industry.

Development and operational challenges have created the need for international knowledge transfer to Bhutan. Preparation, construction, and operation of hydropower in Bhutan have benefited greatly from expertise from Indian states that have deep experience in developing hydropower and similar hydrological and geological challenges (e.g., Himachal Pradesh). Indian expertise and policies from its federal regulatory bodies and institutes—for instance, for dam safety inspections—are transferred to Bhutan. Increasingly, global expertise is brought in to support complex matters, such as tunneling, sediment management, and seismic hazards.[39] International companies are increasingly sought for the role of owner's engineer during preparation and supervision of new project developments. National facilities for servicing electromechanical equipment at all existing hydropower plants have been introduced. As an example, DGPC set up a facility in southern Bhutan to provide hard coating for runners.

There is good awareness of the E&S management issues of hydropower, but regulators and other government agencies do not benefit from capacity development in the same way that those dedicated to hydropower do. The RGoB is well aware of the E&S challenges associated with developing hydropower. The legal framework provides a good basis for E&S management of hydropower. E&S values are included in the MCA conducted by the DHPS for new hydropower development, although they have been accorded a lower weight than the technical and economic aspects.

In Bhutan, the regulations for managing the E&S impacts of hydropower projects are clear, well-defined, and quite robust. The Environmental Assessment Act (2000) requires that an Environmental (and Social) Impact Assessment be conducted for hydropower projects, which in turn is regulated by NEC. However, more attention has been given to the technical aspects of capacity development than to E&S aspects. Human and financial resources are not channeled toward the latter to the extent that they are for technical capacity development, especially within the government institutions. The number of staff at NEC is small, and no department is fully dedicated to hydropower development, despite hydropower's large role in Bhutan's industrial development. Baseline data on environmental variables remain very scarce, especially for biodiversity. Local and international expertise is underutilized for complex E&S issues. The advisory board envisaged by the environmental policy, to be established for the provision of expert advisory services during the EIA process, is not normally created. International experts on E&S management, while part of the developer's preparation consultant teams, are not typically working with and transferring knowledge to the regulatory institutions.

[39] Verbal information from DGPC and MHPA, October 2015.

Cross-sectoral linkages are not strongly emphasized. The knowledge and awareness of hydropower development plans in sister ministries, such as the Ministry of Agriculture and Forests, and the Ministry of Roads, seem low. This results in missed opportunities to focus parallel infrastructure development and land management programs that would benefit hydropower development. Similar to the case of regulatory agencies, resources or knowledge do not seem to be channeled to sister ministries for capacity development of these ministries to support hydropower-smart activities.

Because of the lack of capacity, there are gaps in the present management of E&S impacts of hydropower development compared with international good practice. This study indicates that the key potential environmental impacts related to hydropower in Bhutan, mainly linked to aquatic biodiversity, are cumulative and may be synergistic. They are, thus, typically not easy to detect in an EIA focusing on only one hydropower project, and may not be seen in time until a threshold has passed. The current MCA approach limits the possibility for considering national perspectives and cumulative impacts. Though not an immediate problem for the near-term pipeline, the project-by-project development approach may eventually push impacts from hydropower development beyond the point where the river systems and the natural and cultural values of Bhutan—essential for other sectors to grow—are seriously affected. Lack of capacity and resources is partly at fault. The time has not been taken to update the hydropower master plan on the national level, taking into account cumulative impacts, nor to assess possible mitigation measures on the river basin or regional scale. Such approaches, for conservation of biodiversity as an example, would likely be more efficient than project-based mitigation measures. Lack of resources and manpower has made it difficult to conduct proper baseline studies, which would help determine whether the impacts on biodiversity are severely negative and, if so, in what ways and where exactly.

This study has further indicated weaknesses in the implementation of the ESIA and in avoiding temporary impacts during construction. The independent assessment that used the Hydropower Sustainability Assessment Protocol for the Mangdechhu Hydroelectric Project, for example, highlighted deficiencies in the way downstream flows had been assessed in the EIA, and in the way labor and working conditions, waste, and dust management had been identified and were being managed. Codes of Practice for health and safety are lacking in the contracts for the main contractors. The institutional assessment found a lack of coordination and unclear reporting between the Dzongkhag and NEC for compliance monitoring during construction. This study also identified a number of gaps in managing the social impacts of hydropower. The compensation rates for land acquisition have to be updated; rates have not been updated since 2009. In addition, there is a need to strengthen the ESIA process on social aspects, including the guidelines to fully assess the impacts of hydropower development on livelihoods.

Though these specific examples are not the source of major impacts, they indicate a pattern of insufficient implementation of the regulatory framework and demonstrate how these shortcomings prevent Bhutan's management of E&S impacts of hydropower from fully meeting international good practice. The institutional analysis shows that the lack of manpower and resources for key E&S departments in the government institutions is a major reason for not assuring quality and full compliance with the regulations. As hydropower development in Bhutan accelerates, this lack of capacity will become more acute, risking the emergence of additional management issues.

If hydropower development proceeds too quickly in Bhutan, with a narrow focus on improving technical capacity along the way, public criticism could increase due to E&S management concerns. The focus on rapid development of hydropower, both on the part of Bhutan and India, has created pressure to find and prepare new sites quickly. This will require increased involvement from the already strained institutions involved in environmental clearances and compliance monitoring. Failure to meet this rapidly increasing demand for institutional capacities will increase the risk of management shortcomings, and thus negative impacts, which may stir national and international criticism.

Bhutan will be able to develop more hydropower if it can demonstrate its capacity to mitigate negative E&S impacts and, through robust regulatory functions and transparency, ensure that long-term impacts are taken into consideration. Similarly, duly communicating to the public the benefits and positive impacts, both on a national and local scale, affirmed through monitoring and evaluation, will enhance acceptance of the unavoidable negative impacts. The importance of creating trust and positive sentiments around hydropower is especially important in Bhutan, where ambitious goals for sustainability have been set and great emphasis is placed on natural and cultural values and the happiness of its people.

Capacity building in E&S management can reduce delays in the development of hydropower in Bhutan, resulting in cost savings and earlier revenue streams that would probably amply far outweigh the cost of the capacity building. Hydropower developers in Bhutan cite long lead times and uncertainty around the process to obtain environmental clearances, both during preparation and implementation, as major concerns. This study's institutional analysis indicated that the lack of capacity in DHPS, to facilitate the process, and in NEC and the relevant ministries, to evaluate and give clearances, are bottlenecks that are partly to blame for the long lead times. The lack of manpower and resources further limits the government institutions' ability to interact more frequently with developers, something that would reduce uncertainty and increase understanding of the process.

Considering this study's objectives—to assess the E&S impacts of hydropower development planned under the 10,000 MW initiative and beyond, and identify necessary measures for the mitigation of impacts—the main conclusions are:

- *The key impacts of hydropower development in Bhutan relate mainly to aquatic biodiversity and are cumulative, meaning that they are not immediately of concern but need to get more attention as development accelerates. In addition, as with all large infrastructure projects, there are temporary impacts during construction, which, considering the very rapid and large expansion of hydropower with many parallel projects, must be addressed in a countrywide and coordinated manner.*
- *Despite general awareness and a good regulatory framework for managing the E&S impacts of hydropower in Bhutan, challenges remain in early planning and implementation of the assessment and mitigation of impacts, mainly due to the lack of capacity among key government institutions to assure quality and enforce good practices. Addressing the capacity constraints, and providing the necessary tools, structures, and skills to the key institutions for E&S management of hydropower would benefit both the sustainability of natural and cultural values in Bhutan, and the hydropower and economic development of the country.*

Recommendations to duly address these key impacts and management shortcomings are provided in the next chapter.

Chapter 6
Recommendations

Bhutan has the opportunity to develop hydropower sustainably. Bhutan is blessed with ample hydropower potential and has the opportunity to develop hydropower well and reap the tremendous benefits, while protecting its core natural and cultural values. Compared with many other countries, the physical resettlement required is relatively small. The natural features of Bhutan enables run-of-river or storage projects with relatively small environmental footprints in relation to the installed capacity.

Management of the E&S impacts of hydropower has already come a long way in Bhutan. The Hydropower Sustainability Assessment of the Mangdechhu Hydroelectric Project by independent assessors showed that, in most areas, performance is at the level of international good practice or better. Both the Protocol assessment and the analysis conducted in this study, however, also indicate areas where E&S management can be improved. Some of these relate to potential impacts that are especially relevant for the Bhutanese context.

To address these management gaps, a number of recommendations have been made. These recommendations are directed toward the specific roles of the key stakeholders involved in hydropower development in Bhutan and not just meant to fill those gaps, but also to improve the efficiency of the management of E&S impacts. The recommendations focus on providing the key stakeholders with the tools and capacity to improve and expand the management of the E&S impacts of hydropower.

The recommendations are general in nature. Thus, it is important to specify whom these activities are relevant for, which specific issues they address, and how they can be implemented. The following sections go through each of the recommendations and describe how they could be implemented. The recommendations are listed in random order and complement each other, meaning that the ultimate outcomes will be enhanced if the recommended measures are implemented in parallel.

6.1 Policy updates

Following the recommendations from the 16th Session of the National Council, the DHPS is currently in the process of updating the Hydropower Policy for Bhutan. The 2008 Bhutan Sustainable Hydropower Development

Policy is partly outdated and needs to be revised. The new policy should give the overall framework for the accelerated development of hydropower in Bhutan, and outline the roles and responsibilities of the various institutions involved as well as their modus operandi.

Regarding E&S management of hydropower development, it is recommended that the DHPS use the main findings of this report to inform the policy framework. The new policy should highlight the key identified potential E&S impacts relevant for Bhutan, and stipulate in broad terms how and by whom, these impacts will be addressed. It is essential that the policy revisions address the current resource imbalance between the capacity development and implementation of technical and E&S management of hydropower.

The DHPS, being part of the MoEA and an active stakeholder, should also work to influence policies that are essential for hydropower development but the responsibility of other ministries. For E&S management, this study has highlighted the importance of updating the current compensation levels for land acquisitions stipulated by the 2007 Land Act.

6.2 Strategic roadmap for future hydropower projects

In parallel with the development of the immediate pipeline, it is essential to revisit the principles for planning and development of the remaining hydropower potential and to develop a strategic roadmap. Moreover, such a strategic roadmap for remaining hydropower development in Bhutan is best developed through a consultative process. The ultimate goal is to find the optimal way to meet domestic power requirements and maximize revenues from export while preserving the country's environmental, social, and cultural resources. The hydropower policy, currently being revised by the DHPS, will set the overall direction for the roadmap and in turn be influenced by it.

The main reason for developing a strategic roadmap is to address the principal potential impacts that could over time cause irreversible harm to aquatic biodiversity and other possible cumulative impacts. The strategic roadmap should go beyond the master planning procedures followed in the past, and reflect a holistic approach involving all relevant sectors. The roadmap's final destination should be a realistic action plan for the implementation of hydropower projects, based on the country's (macro-economic and socioenvironmental) absorptive capacity. By including E&S impact assessments for different future hydropower development scenarios, such a roadmap will be able to address the potential *cumulative* impacts, especially those related to river connectivity.

Another reason to develop a strategic roadmap is that it will reduce the requirements regarding the aspects to be covered under the ESIA for *individual* hydropower projects. As the strategic roadmap should address the need for a Cumulative Impacts Assessment and Strategic Environmental Assessments, it will no longer be necessary to conduct these for every new hydropower project. On the other hand, cumulative impacts should be included in every ESIA (see Section 6.3 on guidelines), so that the data contained in the national roadmap may be updated or complemented, but their scope will be considerably less and the information can just be added to the ESIA (no separate document required).

The responsibility for developing the roadmap for hydropower development in Bhutan should lie with the DHPS and the MoEA, as the ministry entrusted with overseeing and planning hydropower development. The reason the DHPS needs to lead this process is that power demand and available technical solutions are the drivers of the roadmap on which hydropower

development can be based. Collaboration with other key stakeholders such as the NEC, GNHC, the MoAF, the TCB, and the MHCA is, however, crucial. These institutions are responsible for much of the input for the strategic roadmap, such as the mapping of protected areas, and data on biodiversity and cultural values. Moreover, the roadmap should be developed in coordination with the sectoral plans for water (IWRM), agriculture, forestry, and tourism. The optimization of trade-offs between hydropower production and protection of environmental, social, and cultural values also requires a transparent and consultative approach to ensure broad ownership of the strategic roadmap.

Capacity building and awareness of the importance of early planning for hydropower are essential for the successful implementation of the roadmap. In addition, all the stakeholders involved should understand the need for incorporating E&S aspects, especially the cumulative impacts, in the planning process.

The main subactivities to arrive at the strategic roadmap are:

- Update the 2004 Hydropower Master Plan, focusing on critically revising technical solutions and cost estimates for hydropower sites;
- Conduct a financial and market study focused on domestic and export demand forecasts for electricity;
- Conduct countrywide, basin-level E&S studies on the cumulative impacts;
- Conduct an optimization study to balance the trade-offs at the national level between hydropower development, impacts on natural and cultural values, and economic development.

Timewise, the update of the technical master plan and the financial and market studies should start immediately, since these activities lie on the critical path. E&S studies should ideally await the results of baseline studies and the mapping of key biodiversity and cultural assets (see Section 6.5 on baseline studies), but also lie on the critical path. The optimization study relies on input from the other subactivities. The estimated total time needed to develop the strategic roadmap is at least two years.

6.3 Sustainability guidelines for hydropower development

To support the Hydropower Policy and facilitate its implementation and enforcement, the country should develop guidelines to ensure sustainability during preparation, construction and operation of hydropower. Those guidelines should encompass more than E&S aspects alone, since *sustainable* hydropower requires that technical, financial, and economic aspects also be considered. Unfortunately, when financial and technical challenges arise in a project, the E&S aspects are often de-emphasized until those major challenges are solved. This tendency strengthens the case for taking a broader look at sustainability, one that features clearly defined E&S management guidelines. Similar to the strategic roadmap, the hydropower policy will provide the overall direction for the sustainability guidelines and refer to them as well.

The main reason for developing comprehensive national guidelines is to mainstream and ensure one set of practices for hydropower development. Otherwise, different developers could end up applying multiple approaches and standards to different projects. The guidelines should provide more details than the Hydropower Policy, and thus be less susceptible to diverse interpretation by developers. Clear guidelines would also make the implementation of permit and compliance processes more efficient.

It is assumed the E&S sections of the sustainability guidelines will, to a large extent, use the existing guidelines contained in the 2012 EA Guidelines for Hydropower and Transmission Lines. However, the development of sustainability guidelines will provide an opportunity to improve the existing guidelines, based on the findings of this study. It is important to place the emphasis on guiding the implementation of the ESIA and on monitoring and compliance of mitigation measures.

The key management gaps related to the most relevant impacts of hydropower in Bhutan that have been identified in this study and it is recommended be specifically addressed in the new guidelines are:

- **Impacts on aquatic biodiversity**: The guidelines should specify how individual projects should assess the likely impacts on aquatic biodiversity and how they should monitor of the impacts and effectiveness of mitigation measures. Special attention for aquatic biodiversity is essential considering that the free-flowing rivers in Bhutan will decrease by 69 percent compared with natural conditions once the 10,000 MW Program Plus has been implemented. It is essential that assessments and mitigation measures focus on preserving overall biodiversity. Stocking of individual fish species should be done in the context of the overall biodiversity preservation and be coordinated with national stocking programs.
- **Environmental flows:** The guidelines should clarify how individual projects should determine minimum downstream flow releases and how they should meet requirements for monitor its implementation. The compensatory flow releases are essential to preserve the diverted river stretches of run-of-river hydropower in Bhutan. This is especially important since the affected stretches will rapidly increase from today's 70 km to more than 500 km once the 10,000 MW Program has been implemented. The guidance will be informed by international good practices and the ongoing studies on e-flows conducted by NEC.
- **Code of Practices (Environmental Specifications):** The guidelines should instruct and propose environmental specifications for management during construction (e.g., labor camp management, occupational health and safety, dust, muck disposal, etc.), which should be included in the bidding documents and contracts for the main contractors of hydropower projects. The adoption of a comprehensive set of environmental specifications for construction for the hydropower sector, including international good practices, will mitigate many of the construction-related impacts currently felt, and can greatly simplify the EIA procedure by eliminating the need to repeat these measures in each project.
- **Cumulative impacts:** The guidelines should clarify how individual projects should assess cumulative impacts. Considering the rapid and countrywide expansion of hydropower in Bhutan, the assessment of cumulative impacts must be mainstreamed in all ESIAs. The assessment of impacts in the ESIA should always be conducted taking into consideration the future hydropower cascade or road network, and mitigation measures should be designed for each individual project to stem as much as possible the potential future cumulative impacts of the whole system. Areas especially important for Bhutan are the potential impacts on migratory fish and the risk of opening up access to protected areas. The assessment of cumulative impacts on valued ecosystem components should therefore always be integrated with the ESIA. However, the need for separate cumulative impact assessments will only be required if the project has not been studied in the context of the national master plan or roadmap.

In addition, the development of sustainability guidelines is an opportunity to address other gaps compared to international good practice in E&S management, even though the associated impacts are relatively modest on the national scale. The process to develop the guidelines will provide an opportunity, through cross-sectoral discussions, to agree on the level of requirements appropriate for the Bhutanese context. The process will also justify and document chosen differences from international proven best practice. The following are the management areas identified in this study where improvement is possible but further consultations are required:

- **Cultural heritage and landscapes:** The potential impact on physical cultural heritage of hydropower development is likely small in Bhutan due to its small footprint. However, the significant emphasis on cultural values in Bhutan and the link to tourism may be a reason to introduce requirements to assess and mitigate potentially broader impacts on the cultural landscape. These requirements would apply to the hydropower projects as well as the associated transmission lines.
- **Focus on livelihoods in Social Impact Assessment:** The Social Impact Assessment for hydropower has mainly focused on the people affected by land acquisition, typically only a few. Because the livelihoods of a larger number of people, including "camp followers," may be affected (positively or negatively) it could be prudent to develop guidelines to increase the focus on livelihoods in the Social Impact Assessment. This could open up opportunities to boost job creation and improve livelihoods after the construction period.
- **GRMs:** Because of traditionally strong community engagements and trust, the GRMs are mainly managed through the local governmental authorities and not directly through the affected people and the project developer. In accordance with international best practices, these procedures could be changed to give more responsibility to the developer and enhance transparency in the process. Doing so would decrease the burden on the local authorities and make the GRM more efficient.
- **Community development and benefit-sharing programs:** Local community development programs are already part of the EMPs for hydropower projects in Bhutan, and the RGoB is using the revenues from hydropower to distribute benefits to the society through the state budget. However, informed by international best practices, more robust and uniform guidance for local livelihood and benefit-sharing programs for project-affected people could be considered. The main reasons for such guidance would be to enable the same level of benefits for all projects, and reduce potential not-in-my-backyard phenomena.
- **Disclosure of documents and community consultations:** The current practice in Bhutan is not to publicly disclose key documents, such as the EIA and the EMP. In accordance with international best practices, it may be prudent to include disclosure requirements in the sustainability guidelines. Disclosure of documents and community consultations related to assessment and management of E&S impacts of hydropower lower the risk of speculation, which can generate negative criticism.
- **Compliance framework:** There is currently a lack of clarity regarding the reporting that the hydropower developers need to do on the clearance conditions or other aspects during project construction. The guidelines should clarify the compliance elements that the developers need to provide regular reporting on (to the DHPS and NEC) and disclose on their website for the benefit of other stakeholders.

- **Catchment Area Treatment Plans:** The Hydropower Policy already stipulates the provision of 1 percent royalty energy for integrated catchment area management. The guidelines should clarify the roles and responsibilities for implementing these plans and guide investments toward those activities and locations that are most relevant for *sustainable* hydropower generation such as erosion control and riverine sediment reduction.

An essential component of the new sustainability guidelines should be clearly demarcated roles and responsibilities for the E&S management of hydropower. The guidelines should complement the new Hydropower Policy by clearly specifying the various roles and responsibilities in this context and by focusing on their efficient implementation. The responsibilities and procedures for the monitoring of impacts during and after construction should receive special attention, and be vested with the developer to a larger degree than is currently the case.

The responsibility for developing the sustainability guidelines should lie with the DHPS since the guidelines will cover technical as well as E&S aspects. Similar to the strategic roadmap, collaboration with other institutions will be crucial. For the sections dealing with E&S issues, the DHPS will need to work closely with NEC, the GNHC, the MoAF, and the MoHCA. The interaction with NEC on methodologies developed for downstream flow determination and the MoAF on fish and fauna monitoring practices will be particularly important. Collaboration with DGPC will also be necessary to ensure that the guidelines are implementable.

No specific subactivities are recommended for developing the sustainability guidelines. However, a first step should be to map the existing policies, guidelines, and strategies as a basis for the new guidelines. Following the mapping and direction set by the new Hydropower Policy, a first set of guidelines should be developed by the DHPS, with support from international and local experts. These guidelines should serve as input to a consultative process in which other key stakeholders can have their say. The development of the guidelines should start as soon as possible and will probably take 6–12 months to complete.

6.4 Capacity building for environmental and social clearance process

Capacity development for regulatory agencies and key stakeholders should be extended, and cross-sectoral coordination should be initiated in the management of the E&S impacts of hydropower. Capacity building should focus on improving the clearance process for E&S permits for hydropower development. This includes not just the regulatory approval procedure, but the whole process of quality assurance of the preparation and application documentation, and ensuring coordination among all key stakeholders involved.

Targeting capacity building targeted at the E&S clearance process has multiple benefits. A strong regulatory process will force the developer to conduct high-quality preparation to avoid the risk of being required to do additional studies, which could result in delays in the project schedule. High-quality preparation means that E&S impacts will be identified at an early stage, will be well understood, and thus allow for appropriate avoidance or mitigation measures to be proposed and implemented. A strong and *predictable* regulatory process saves time in the preparation of hydropower projects and makes it easier for the developer (reliable time estimates) to coordinate the permit approval process with other preparatory activities.

The key players in the E&S clearance process are NEC, the DHPS, and DGPC, although No Objection Certificates and clearances are required from a host of institutions. NEC, as the regulatory body, is ultimately responsible for providing the clearance. DGPC, which is increasingly developing its own projects under PPP or JV models, will be responsible for the preparation studies for many of the hydropower projects in the near-term pipeline. The DHPS is a key institute—a spider at the center of the net—a facilitator for coordinating the various steps involving government inputs and responsible for the preparation of new projects under the IG model.

The subactivities of the capacity-building program for improved clearance processes should focus on three major roles and create an overarching, cross-sectoral function:

- **Improving NEC's regulatory role**
  - An organizational audit should be conducted to improve the structure of NEC so some of its staff can be made available to assume the regulatory responsibilities. Key aspects are the need to separate regulatory duties from "supportive" duties (that is, conducting studies), the need for hydropower-specific subdepartments or staff, and the need to bring in more social development expertise.
  - A comprehensive training and skills enhancement program focused on evaluating preparatory studies for hydropower should be implemented. Among other things, this program should aim to enhance knowledge to with the level of international practices, especially in areas important for Bhutan such as biodiversity and cumulative impacts. Special attention should also be given to building up basic knowledge in the social aspects of hydropower, something that has not been a NEC priority area to date.
- **Improving DHPS's facilitation and preparation roles**
  - Similar to NEC, an organizational audit should be conducted to improve the structure of DHPS so key staff can be made available to manage the E&S impacts of hydropower. The audit should focus on two specific DHPS roles in the clearance process: as a quality assurer and facilitator of the process.
  - Also similar to NEC, a comprehensive training program for DHPS staff should be implemented around international good practices for the E&S aspects of hydropower. The facilitator role requires a broad understanding of all aspects of sustainable hydropower development. The DHPS staff should therefore also be trained in procuring and supervising large consultancies for the preparation of DPRs and ESIAs.
- **Improving DGPC's (or the project developer's) capacity to prepare ESIAs and clearance applications**
  - A training program should be implemented, with NEC and the DHPS in the role of trainers to the largest extent possible, that focuses on raising the understanding and knowledge within DGPC of the E&S clearance process of a hydropower project.
- **Improving coordination and streamlining the clearance process**
  - Led by NEC and the DHPS, an analysis should be conducted with the aim of improving coordination of hydropower planning and preparation, and streamlining the E&S clearance process for new projects. One way to improve

coordination is the creation of a cross-sectoral committee that would meet regularly to enhance understanding of the hydropower process and allow cross-sectoral issues and opportunities to be discussed.

- In the wake of such an agreement, the coordination mechanisms outlined above should be implemented as soon as possible to agree on a new, streamlined process for clearance, and to provide a forum for feedback on the development of a strategic roadmap, sustainability guidelines, and baseline studies.

Capacity building, that is, training and skills enhancement, should be based on the Hydropower Sustainability Assessment Protocol, which provides a balanced set of topics for hydropower planning, development, and operations (Table 6-1), agreed by an international, multistakeholder forum that includes the hydropower industry, civil society organizations, and financing institutions. For each topic, there is a description of requirements for reaching international good practices and internationally proven best practices. The Protocol should be used as a framework for the training, which can be supplemented with topics that are especially important in the Bhutanese context. The capacity building and training should be further coordinated with the development of sustainability guidelines, which will be customized for Bhutan, as well as the baseline studies. It is anticipated that training and skills enhancement will target two different levels—a broader group of stakeholders seeking general knowledge on the E&S aspects of hydropower, and a few dedicated staff requiring in-depth knowledge and hands-on training.

The cross-sectoral function should focus on coordination and sharing of responsibilities for planning and development of hydropower projects. Considering the constraints of NEC, it is desirable to share the burden currently resting on the regulatory agency and broaden capacity. While the regulatory agency must maintain decision-making authority, other government departments could provide support—by contributing expertise or conducting baseline studies. The participation of a cross-sectoral committee, to be established taking into account the results of the analysis led by DHPS and NEC, and to be informed by the new Hydropower Policy. Guidance should also be derived from the sustainability guidelines, still to be developed. Besides the DHPS, NEC, the GNHC, and DGPC, other stakeholders likely to become part of such a committee are the BPC, BEA, MoAF, MoWHS, NLC, MOHCA, and TCB.

NEC and the DHPS should assume joint responsibility for the capacity building for clearance processes. Though capacity-development programs must be customized for each of the institutions involved, it would be beneficial if the same service provider undertakes the design and implementation of the training and skills enhancement. This will ensure that the level and focus of training are the same for all key stakeholders. The DHPS should be responsible for the design and setting up of a coordinating body among key stakeholders because such a group would cover aspects going beyond E&S management of hydropower.

Capacity building is not a one-time exercise; rather, it is a gradual process that takes time. It is therefore anticipated that a capacity-building program will run over the course of at least one year. Given that the organizational changes to be made within the key institutes will take time, the program may even have to be extended beyond one year.

Table 6-1 Topics included in the hydropower sustainability assessment protocol

Topics toward which sustainability is assessed	P	I	O
Communications and consultation	X	X	X
Governance	X	X	X
Demonstrated need and strategic fit	X		
Siting and design	X		
Environmental and social impact assessment and management	X	X	X
Integrated project management	X	X	X
Hydrological resource	X		X
Asset reliability and efficiency			X
Infrastructure safety	X	X	X
Financial viability	X	X	X
Project benefits	X	X	X
Economic viability	X		
Procurement	X	X	
Project affected communities and livelihoods	X	X	X
Resettlement	X	X	X
Indigenous peoples	X	X	X
Labor and working conditions	X	X	
Cultural heritage	X	X	X
Public health	X	X	X
Biodiversity and invasive species	X	X	X
Erosion and sedimentation	X	X	X
Water quality	X	X	X
Waste, noise and air quality		X	
Reservoir planning / preparation and filling / management	X	X	X
Downstream flow regimes	X	X	X

Note: P = Preparation, I = Implementation, and O = Operation.

6.5 Baseline data studies essential for environmental and social management

Targeted baseline studies to fill data gaps and build up national references for future monitoring and evaluation are crucial for improved management of E&S impacts of hydropower in Bhutan. The potential impacts on aquatic biodiversity are mainly based on the relatively large geographical influence of the rivers in Bhutan. The actual impacts are mostly unknown, which is why harm to aquatic biodiversity has been identified as the key potential impact of hydropower. A similar argument can be made for hydropower's potential impact on cultural landscapes, which is mainly based on the traditionally high values the Bhutanese people assign to architecture, the natural environment, community, and people's lifestyles. However, since no countrywide mapping of cultural landscapes is available, it is unknown to what degree the planned hydropower will actually affect these values. In both examples, countrywide inventories and analyses are needed to generate the basic data to be used by ESIAs to identify local impacts and determine their relevance.

Key areas that requires national baseline studies in Bhutan are the mapping of biodiversity and cultural values. Information on these two areas is especially important as input for the strategic roadmap, the sustainability guidelines, and the capacity building for hydropower development. Considering the vast amount of work the creation of nationwide, detailed inventories and documentation would require, such studies must be conducted in a stepwise manner, starting with gathering the most crucial data and information.

Mapping of biodiversity

- As a first step, a common georeferenced database should be created, based on existing work. Protected areas in Bhutan are already relatively well mapped for terrestrial biodiversity. Fish assessments have been carried out by WWF and NCA[40] (National Centre for Riverine and Lake Fisheries). These data should be put together in a common database and subsequently analyzed to try and draw conclusions applicable to the national level.
- Based on the analysis of work already conducted, a single-season monitoring campaign should be designed and implemented first to fill major data gaps. The focus of this campaign should lie on gathering key information to complement available data most relevant for hydropower development in the near pipeline. It is recommended that this campaign target aquatic biodiversity, given hydropower's large effect on river connectivity in Bhutan.
- The first monitoring campaign should be followed up with regular campaigns to gradually expand the database. The focus of these subsequent campaigns will to a large degree be determined by the results of the earlier work.

Mapping of cultural values and landscapes

- As a first step, the preliminary interactive cultural map of Bhutan prepared by the MOHCA should be finalized and made available to the public. This map is an analysis of Bhutan's people, assets, landscapes, and ways of life, and aims to serve as information for the development and implementation of national strategies. The cultural map should to the extent possible be completed using existing information. To this end, a cross-sectoral team should be established to provide advice and input.
- As a second step, with the support of cultural mapping experts, further data should be collected and presented in a variety of formats—graphs, aerial photographs, satellite-produced images, statistical databases, etc. Using these various information sources, a comprehensive view of the country's cultural resources could be stored and the documented data further refined. As cultural mapping requires communities to identify and document local cultural resources, to secure community inputs in an effective manner, various media should be used in this context, including websites, press releases, radio broadcasts, and an e-community survey.

It is acknowledged that mapping studies can widely range in scope—from very general to highly detailed. The level of detail is likely to be influenced by available resources. It is recommended that the choice of geographic locations for measurement campaigns be based on the locations of hydropower development

[40] The National Centre for Riverine and Lake Fisheries (under the Department for Livestock and Forestry) is currently compiling a database of fish species found in Bhutan's rivers, as part of a three-year Fish Fauna Assessment Project that started in 2013, with funds from the Bhutan Trust Fund for Environmental Conservation (http://www.bbs.bt).

projects in the near-term pipeline and initially prioritize reconnaissance over detail to get an overall picture of the impacts on aquatic biodiversity, which can guide future mapping activities in the future.

Besides the mapping studies, two other areas are relevant to hydropower's potential impact on aquatic biodiversity and deserved closer study:

- **Studies on environmental flows:** NEC has already initiated studies on "e-flows," which will provide essential input to the strategic roadmap, sustainability guidelines, and capacity building for hydropower development in Bhutan. It is essential that these studies, focused on methodology, be finalized soon to give timely input to the parallel activities.
- **Studies on the efficiency of biodiversity offsets:** Artificial fish production in hatcheries to stock upstream and downstream of dams has been suggested for many of the hydropower projects built or still under construction. Because of hydropower's significant impact on river connectivity in Bhutan, a thorough understanding of the efficiency and effect on the overall ecosystem of this mitigation measure is needed to guide the development of (i) the strategic roadmap and (ii) the sustainability guidelines for development of future hydropower. It is recommended that existing evaluation programs for sites where fish hatcheries are already in place be supported with further studies.

NEC, as the main environmental institution in Bhutan, should act as coordinator for the baseline studies on E&S impacts of hydropower. However, the respective relevant agencies should be responsible for conducting the individual studies. For instance, responsibility for the mapping of fish should lie with the MoAF, while the mapping of cultural values and landscapes should lie with MOHCA. Given its long experience in Bhutan and specialized knowledge of biodiversity preservation, the WWF is also an important resource to support the baseline studies.

Conducting baseline studies and subsequently monitoring data are continuous, never-ending activities, since there will always be a need for additional, more detailed data and ongoing updating of existing data. At the same time, reliable data are crucially important for the hydropower development planned for the next few years, so there is an urgency to start collecting relevant data as soon as possible. More specifically, in the next 12 to 18 months, a common GIS database should be created for data gathered through past activities and complementary data monitoring should be started or baseline data studies conducted.

6.6 Capacity building for compliance monitoring and audits

In addition to capacity building for the clearance process, which is aimed at the preparation phase, it is essential to develop capacity for improving compliance with agreed mitigation measures during construction and operation. Furthermore, monitoring makes it possible to learn from the results and change mitigation measures accordingly to be more effective. While the capacity building for compliance should build on the programs developed for the clearance process, it should focus on developing partially new structures and guidelines for monitoring and documentation, and less on skills enhancements.

The development of a strong monitoring capacity for E&S impacts of hydropower has a dual purpose: (i) to ensure that impacts are mitigated in accordance with the agreed

EMP; and (ii) to enable the documentation of impacts, both positive and negative, of the hydropower development. The latter has gained increasing prominence in hydropower development worldwide as civil society has increased its interest in the sector. Hydropower developers often ignore the need for thorough documentation of impacts, despite the fact that the owner's engineering team usually has extensive relevant knowledge. In some cases, developers have been unable to corroborate, with data, the alleged (reported) effects and effectiveness of the mitigation measures. Failure to provide "proof" leaves room for speculation and criticism of the project.

In Bhutan, it is especially important to monitor and document the positive socioeconomic benefits of hydropower. The development of hydropower is supposed to bring large revenues to the country. Through the MCA currently used to steer HEPs to less developed areas, the potential benefits for local communities are emphasized in the planning process. Against this background, it is vital to document these benefits to build proof that the positive impacts are by far larger than the potential negative impacts.

It is recommended that the capacity building for compliance monitoring and audits mainly target four areas:

- **Improving the system for day-to-day supervision by DEOs and NEC:** The lack of manpower and resources for checking compliance with the EMP and providing clearances during construction have been identified as gaps for managing E&S impacts of hydropower.
  - An organizational audit should be conducted to improve the organization of NEC and the DEO for their regulatory responsibilities to ensure compliance of the EMP. Key questions that need to be looked at are the respective roles of the two institutions and the reporting mechanisms. Once the roles are defined, an assessment of staff capacity should be conducted to assess capability to fulfil these roles.
  - The EMP and clearance process followed during construction and operation should be critically reviewed to assess possibilities to streamline the compliance monitoring process. The focus should lie on the possibility of enhancing and extending the hydropower developer's self-monitoring and documentation preparation capabilities to decrease the burden on the regulatory authorities. Specifically, the self-monitoring should be designed to proactively identify and alert to potential risks that require involvement of NEC or a DEO. If such a system were in place and duly functioning, the need for regular visits by regulatory authorities would be reduced.
  - Following the above analyses, key staff of NEC and DEO should receive training to strengthen their skills and roles in compliance monitoring.
- **Create structures and guidelines for independent surveys:** Introduction of independent monitoring mechanisms, such as third-party inspections for key E&S parameters for hydropower projects to build knowledge and understanding of the impacts of hydropower development in Bhutan.
  - It is recommended that guidelines and templates for at least three major surveys or impact evaluations be developed: baseline (before construction starts), mid-term (during construction) and completion (after commissioning). These surveys, which are the responsibility of the developers, should mainly focus on indirect impacts—measured by livelihood parameters such as health, income, assets, and school attendance for affected

households—and biodiversity parameters, indicating the presence of key aquatic and terrestrial species, etc. The surveys should be conducted by independent institutions, for instance, universities, and be public documents. Such surveys are very powerful tools to inform the public of the actual impacts of hydropower in Bhutan, and to guide improvements in E&S management for future hydropower projects.

- The major surveys can potentially further be augmented by exploring possibilities for regular monitoring in between the time of the three milestone surveys. Possible ways could be through community monitoring or by utilizing new technology through real-time monitoring utilizing internet.

- **Create capacity for internal audits by DHPS/DGPC using the new sustainability guidelines:** Adaptive management is only efficient if there is a mechanism in place to identify gaps. Internal audits that use a structured methodology and standard template could be used in this context. The internal audits are also a powerful communication tool to show compliance with regulations and good practices, similar to the independent surveys. Internal audits of E&S management are especially useful during construction, when large technical challenges often take center stage, but can also be used in the preparation stage to assess compliance with good practices.

  - It is recommended that the procedures developed for the internationally recognized Hydropower Sustainability Assessment Protocol be used as the basis for developing internal audit routines for E&S aspects. Similar to the Protocol, clear requirements for good practices reflecting the new sustainability guidelines can be set, and a structured methodology can be developed to assess whether these requirements have been met.
  - It is recommended that the capacity for carrying out internal audits be built within the DHPS and DGPC, which are directly involved in hydropower projects under all models (IG, JV, and PPP) in Bhutan. A small group consisting of four or five key staff from the E&S divisions of these organizations should be trained to conduct internal assessments. Training should include at least one audit exercise of a hydropower project under preparation or construction.

- **Extended use of International Panel of Experts:** International and national experts are already used for advisory services during preparation and implementation of hydropower projects in Bhutan on an ad hoc and needs basis. It is recommended that the use of a Panel of Experts (PoE) become standard for new hydropower projects in Bhutan. Developers should have the panel in place before starting construction (in some cases, having a PoE even during preparation is suggested). The function of the PoE is not primarily to check compliance but rather to advise the developer on methods to solve the often complex and case-specific challenges encountered in hydropower projects.

  - The PoE should be involve national and international experts, assigned on a part-time basis, and have the resources to make regular site visits. The team should work in close collaboration with developers, NEC, and other relevant government organizations to bring in international experience and take advantage of lessons learned from previous and parallel projects developed in Bhutan.

The above subactivities involve capacity building and development of new guidelines and procedures. The development of these new structures and guidelines will largely rely on the institutional capacity of the key stakeholders; it is therefore recommended that the latter process

be made part of the capacity-building package. The above subactivities are also closely linked to the capacity building to improve clearance processes and thus could be implemented together.

The responsibility for capacity building for compliance monitoring and audits should lie with each respective organization. It is recommended that the capacity-building components for improved clearances and compliance monitoring be launched as one package, primarily targeting the DHPS and NEC; however, the specific subactivities should be directed at the relevant organization. The capacity-building program should run over the course of at least one year.

6.7 Prioritization and way forward

The key stakeholders in Bhutan have already started the process of improving sustainable management of hydropower. The DHPS has started updating the 2004 Master Plan; NEC has initiated detailed studies to estimate environmental flow in the rivers of Bhutan; DGPC has developed a Social Safeguards Manual to promote the development of hydropower projects in a socially responsible manner and according to sound internationally accepted practices. Although these first steps have been taken, implementing the above recommendations remains a huge task that will require large resources and a strong focus. Bhutan has a large government sector and there is little room for expansion in the short term. Competition for state budget funds is strong, given the many basic development needs Bhutan still has. It is therefore wise to be practical: start with the low-hanging fruits, and aim for a stepwise, gradual increase in capacity to manage the E&S impacts of hydropower.

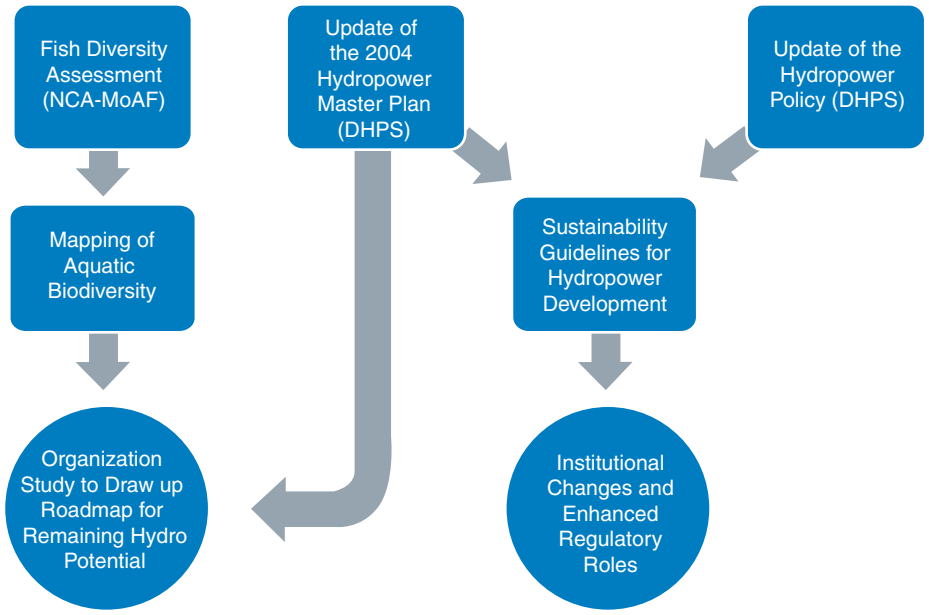
Activities to improve the E&S management of hydropower in Bhutan should be implemented step-by-step, starting with the creation of tools for better management, institutional capacity building, data collection, and consolidation of knowledge and information into strategic plans (Figure 6-1). Updating the Hydropower Policy, informed by the findings of this study, and developing guidelines for preparation and implementation of hydropower projects through a consultative process, can be done relatively quickly and will increase awareness of the need for improved management. The development of routines and guidelines for conducting independent surveys and internal audits related to the E&S management by DHPS, should also be relatively easy to fast-track to put pressure on hydropower developers to adopt the new guidelines.

Developing these tools will start the much-needed capacity building, while a more permanent institutional development, demanding organizational changes and new funding mechanisms, will obviously take longer. Nevertheless, capacity building should start as soon as possible, aimed at increasing knowledge and skills, and a more efficient use of the available resources. Similarly, the creation of national databases should start with making existing data available through GIS databases accessible on the Internet, and gradually supplementing these with new data, as resources become available.

Although strategic plans are needed as soon as possible to guide the next batch of hydropower projects to be developed, comprehensive, nationwide plans require a large amount of input data and knowledge of the aquatic and terrestrial systems of Bhutan. These plans will therefore have to wait until the necessary capacity has been built and baseline data have been compiled. The current initiative to update the technical master plan should be seen as an opportunity to in parallel build up the minimum input data necessary for conducting basin-scale assessments of the cumulative impacts of hydropower on the country's major rivers.

Figure 6-1 Sequencing of main recommendations and relationship to existing RGoB initiatives

Activity	2016		2017		2018	
	Jan–Jun	Jul–Dec	Jan–Jun	Jul–Dec	Jan–Jun	Jul–Dec
Existing initiatives by RGoB						
Fish diversity assessment (NCA-MoAF)	■	■				
Development of methods to determine environmental flows (NEC)	■	■				
Update of the Hydropower Policy (DHPS)	■	■				
Update of the 2004 Hydropower Master Plan (DHPS)		■	■	■		
Suggested recommendations by this study						
Sustainability Guidelines for Hydropower Development		■	■			
Capacity building						
• Awareness and knowledge enhancement		■	■			
• Creating capacity for internal audits by DHPS and developers		■	■			
• Creating templates and capacity for independent surveys		■	■			
• Institutional changes and enhancement for regulatory roles				■	■	
Baseline studies of data essential for environmentally and social management						
• Mapping of aquatic biodiversity			■	■		
• Mapping of cultural values and landscapes			■	■		
Strategic Roadmap for Future Hydropower Projects						
• Financial and market study			■	■		
• Countrywide studies focusing on cumulative impacts			■	■		
• Optimization study to draw up roadmap for remaining hydropower potential					■	■



Appendix A
Existing and Potential Hydropower in Bhutan

Table A-1 Hydropower development scenarios

Status	Project name	Installed capacity (MW)
Existing		**1,606**
	Basochhu L/S	40
	Basochhu U/S	24
	Chukha	336
	Dagachhu	126
	Kurichhu	60
	Tala	1,020
Under construction		**3,658**
	Mangdechhu	720
	Nikachhu (Tangsibji)	118
	Punatsangchhu I	1,200
	Punatsangchhu II	1,020
	Kholongchhu (600 MW)	600
10,000 MW Program Plus		**8,932**
	Amochhu	540
	Bunakha	180
	Chamkhar-I	770
	Kuri-Gongri	2,640
	Sankosh Main	2,500
	Sankosh Lift	60
	Wangchhu	570
Under DPR	Dorjilung (Rotpashong)	1,230
Under DPR	Nyera Amari-I	125
Under DPR	Nyera Amari-II	317

Status	Project name	Installed capacity (MW)
Selected potential sites		**6,995**
Prefeasibility	Aiechhu	83
Under DPR	Chamkhar-II	590
Prefeasibility	Chamkhar-IV	364
Prefeasibility	Dagachhu-II	140
Prefeasibility	Dangchhu	170
Prefeasibility	Gamri-I	45
Prefeasibility	Gamri-II	85
Reconnaissance study	Gamri-V	91
Prefeasibility	Jomori	107
Reconnaissance study	Kholongchhu (94 MW)	94
Prefeasibility	Khomachhu	363
Prefeasibility	Manas	2,800
Reconnaissance study	Mochhu-I	660
Reconnaissance study	Mochhu-II	450
Reconnaissance study	Pachhu	77
Reconnaissance study	Parochhu	114
Reconnaissance study	Piping	55
Reconnaissance study	Puna-III	600
Prefeasibility dropped	Shongarchhu	107
Balance HEP		**3,999**
No detailed studies	Amochhu-I	747
No detailed studies	Amochhu-II	500
No detailed studies	Bomdeling	130
No detailed studies	Burgongchhu I	69
No detailed studies	Burgongchhu II	70
No detailed studies	Chamkharchhu-III	1,247
No detailed studies	Chamkharchhu-V	97
No detailed studies	Cherchhu	45
No detailed studies	Cherichhu	76
No detailed studies	Darachhu-I	79
No detailed studies	Gamri-III	80
No detailed studies	Gayzamchhu	53
No detailed studies	Gobari	43
No detailed studies	Gumthang	108
No detailed studies	Krissachhu	32
No detailed studies	Phochhu	132
No detailed studies	Rimjigang	46
No detailed studies	Samchhu	71
No detailed studies	Shergarchhu	27
No detailed studies	Sherichhu	36
No detailed studies	Sichhu	78
No detailed studies	Thampochhu	95
No detailed studies	Thimphuchhu	57
No detailed studies	Yemkhari	81
Grand total		**25,190**

Appendix B
Geographical Analysis of Potential Impacts

To support the analysis of potential E&S impacts associated with scaling up hydropower investments in the future, a geographical analysis was carried out to highlight the key potential issues from the national perspective. It was based on four scenarios of cumulative hydropower development: (i) existing projects; (ii) projects under construction; (iii) a revised 10,000 MW program; and (iv) other potential sites in the reconnaissance or prefeasibility stage. The detailed project listings for the scenarios are provided in Appendix A.

Potential environmental impacts of hydropower facilities and transmission lines

Impacts on aquatic connectivity and river flow

Hydropower development, particularly with cascading plants on a single river, can affect a river system by changing its water quantity, water quality, and water connectivity, and by causing river fragmentation. As regulating structures are added to the river system, the length of the river that remains free-flowing decreases over time. This decline in connectivity, in turn, affects the ability of rivers to perform their ecosystem functions such as sediment and nutrient transport. Fragmentation of the river also reduces the self-cleansing ability of the river to recover from and dilute the impact of surrounding sediment and pollution runoff from the catchment, leading to a decline in water quality. Increased fragmentation of the river and potential changes in water quality may also affect fish and other aquatic species in the river. Changes in river conditions—from fast-flowing, turbulent conditions, to slower, shallower flow in some stretches—may result in some species accustomed to or requiring specific water characteristics giving way to opportunistic species that are more adapted to the conditions further downstream.

Affected River Stretches.[41] The total affected river stretch includes the length of the reservoir (if applicable) and the dewatered stretch, that is, the length of river between the intake structure and the outlet. For the purpose of this analysis, only major rivers are included. The

[41] Data on the hydropower facilities are from the Department of Hydropower and Power Systems. Data on boundaries and geological features are from the Department of Forests & Park Services, and the U.S. Geological Survey.

Table B-1 Affected river stretches and reservoir area by scenario

Indicator (cumulative)	Existing	+ Under construction	+ 10,000 MW Program Plus	+ Prefeasibility/ reconnaissance
Installed Capacity (MW)	1,606	5,264	14,196	21,191
Affected River Stretch (km)	68.6	162.4	501.2	953.9
Reservoir Area (sq. km)	1.45	4.3	34.3	39.6

Table B-2 Free-flowing river stretches by scenario

Indicator (cumulative)	Existing	+ Under construction	+ 10,000 MW Program Plus	+ Prefeasibility/ reconnaissance
Installed Capacity (MW)	1,606	5,264	14,196	21,191
Free-Flowing River Stretch (km)	1,931	1,652	1,495	1,099
Free-Flowing River (%)	89	76	69	50
Total Length of Major River (km)				2,168

affected river stretch is intended to convey the length of river for which the flow regime will be dramatically altered due to water diversion for power generation or due to storage. Currently, this affected river stretch stands at 68.6 km but, as the projects under construction come online, this figure is expected to more than double. With the introduction of the remaining projects in the revised 10,000 MW Program, this fragmentation will actually increase by a factor seven (Table B-1, Figures B-1, B-2 and B-3).

Free-Flowing River Stretches (Major Rivers).[42] This refers to the total length of major river stretches above the furthest upstream dams on each river. It is intended to convey the total length of major rivers that are unregulated, and thus retain most or all of the key characteristics that support ecosystems, including connectivity and a natural flow regime. For the purpose of this analysis, the length of river stretch is calculated only within the national boundaries of Bhutan and does not account for any regulation provided by infrastructure upstream in other territories. For projects with reservoirs, the free-flowing river stretch ends where the most upstream reservoir begins. With the current installed capacity of 1,606 MW from major hydropower projects, the vast majority of Bhutan's rivers are free-flowing for long stretches. As more projects come online, including those that are at the prefeasibility or reconnaissance phase, this indicator will probably decline to half, that is, 50 percent of the major river network (Table B-2, Figures B-4, B-5 and B-6).

Impacts on the protected areas network

Hydropower plants can also affect biodiversity through the destruction of habitats. Such impacts can be direct, because of the footprint of hydropower schemes, including ancillary infrastructure (access roads, residential complex, nonresidential complex, contractor facility and workshops, disposal sites), or indirect, as a consequence of opening up of the adjacent areas through access roads built for construction purposes. Vegetation removal often leads to the loss of plants, which have their inherent biological value but also provide food and cover for many birds and animals. Opening up of remote areas can also lead to an increase in poaching.

[42] Data on the hydropower facilities are from the Department of Hydropower and Power Systems. Data on boundaries and geological features are from the Department of Forests & Park Services, and the U.S. Geological Survey.

Table B-3 Impacts of hydropower facilities on protected areas and corridors by scenario

Indicator (cumulative)	Existing	+ Under construction	+ 10,000 MW Program Plus	+ Prefeasibility/ reconnaissance
Installed Capacity (MW)	1,606	5,264	14,196	21,191
Affected Protected Areas Network (sq. km)	14.72	24.43	35.31	178.03
Affected Protected Areas Network (%)	0.06	0.10	0.14	0.73
Total Protected Areas Network (sq. km)				24,354.1

Table B-4 Impacts of transmission lines on protected areas and corridors by scenario

Indicator (cumulative)	Existing transmission network	+ Transmission network under construction
Transmission Lines through Protected Areas Network (km)	120.03	201.34
Affected Protected Areas Network (km^2)	4.27	9.58
Affected Protected Areas Network (%)	0.02	0.04
Total Protected Areas Network (km2)		24,354.1

Impacts of Hydropower Facilities on Protected Areas and Buffer Zones.[43] The intention of this analysis is to define an area around each hydropower project within which the aforementioned impacts may occur. While the impact area around a project is highly site-specific and dependent on a number of factors, this analysis seeks to estimate a reasonable area that can be extended to the four scenarios of hydropower development being examined. For this purpose, a 2 km radius is marked around the dam/intake structure of each project, and potential overlaps with protected areas and buffer zones are highlighted. As seen in Table B-3, the extent of the protected areas network affected is five times larger when projects in the prefeasibility/reconnaissance phase come online compared with development of projects planned under the revised 10,000 MW Program. *In absolute terms, however, the extent of the protected areas network likely to be affected by hydropower facilities and ancillary infrastructure (excluding transmission lines) is very small* (Figures B-8, B-9 and B-10).

Impacts of Transmission Lines on Protected Areas and Buffer Zones.[44] The aim of this analysis is similar to the above, but confined to the potential impacts of transmission lines on the protected areas network. The affected area is in this analysis defined by Bhutan's official RoW clearances on either side of the transmission lines for different voltages: 400 kV (26 m); 220 kV (20 m); 132 kV (13.5 m) and 66 kV (8 m) (Table B-4, Figures B-11, B12 and B-13).

Potential social impacts of hydropower facilities and transmission lines

Impacts on villages and social services infrastructure

The biggest social impacts of hydropower development are associated with the

[43] Data on the hydropower facilities come from the Department of Hydropower and Power Systems. Data on boundaries and geological features are from the Department of Forests & Park Services, and the U.S. Geological Survey. Data on the protected areas network come from the Department of Forests & Park Services.

[44] Data on the transmission lines come from the Bhutan Power Corporation. Data on boundaries and geological features come from the Department of Forests & Park Services, and the U.S. Geological Survey. Data on the protected areas network come from the Department of Forests & Park Services.

Table B-5 Impacts of hydropower facilities on villages by scenario

Indicator (cumulative)	Existing	+ Under construction	+ 10,000 MW Program Plus	+ Prefeasibility/ reconnaissance
Installed Capacity (MW)	1,606	5,264	14,196	21,191
Affected Structures (#)	320	892	2,148	3,310
Affected Villages (#)	21	82	146	212

Table B-6 Impacts of transmission lines on villages by scenario

Indicator (cumulative)	Existing transmission network	+ Transmission network under construction
Affected Structures (#)	520	191
Affected Villages (#)	587	221

transformation of land use in the project area and the displacement of people. Global experience has shown that resettlement is immensely disruptive to the communities affected and can have long-term effects on livelihood and well-being. In Bhutan, the displacement impacts of hydropower projects so far seem to have been minimal because project footprints have been small and mainly in uninhabited areas. Another factor is the preference given to acquire government land, particularly reserved forests, over private land, and the provision of land-for-land compensation to the project-affected communities. Landscape changes have also been limited—project-affected areas normally encompassing only a few square kilometers per project.

Impacts of Hydropower Facilities on Villages and Structures.[45] The *number of affected structures* refers to those that fall within a 2 km buffer around the dam/intake structure (Table B-5). The *number of affected villages* refers to the number of unique villages that those structures belong to. While the impact area around a project is highly site-specific and depends on a number of factors, including access roads, camps, and other ancillary infrastructure, this analysis seeks to estimate a reasonable area that can be extended to the four scenarios of hydropower development being examined.

Impacts of Transmission Lines on Villages and Structures. The number of affected structures refers to those that fall within the official Right-of-Way clearances of transmission lines of different voltages (Table B-6). The number of affected villages refers to the number of unique villages that those structures belong to.

Impacts of Hydropower Facilities on Health Facilities and Schools.[46] As above, the number of affected schools and health facilities refers to those that fall within a 2 km buffer around the dam/intake structure (Table B-7).

Impacts on cultural assets

Physical cultural resources are important as sources of valuable scientific and historical information, as assets for economic and social development, and as integral parts of a people's cultural identity and practices. No major impacts from existing hydropower plants on cultural heritage were brought to the World Bank team's attention during the preliminary

[45] Data on settlements, health clinics and schools is from the National Statistical Bureau.

[46] These data come are from a mapping project being undertaken by the MoHCA. The underlying sources are the National Statistics Bureau, Division for Conservation of Heritage Sites, the National Land Commission, and the Ministry of Agriculture.

Table B-7 Impacts of hydropower facilities on schools and health facilities by scenario

Indicator (cumulative)	Existing	+ Under construction	+ 10,000 MW Program Plus	+ Prefeasibility/ reconnaissance
Installed Capacity (MW)	1,606	5,264	14,196	21,191
Affected Schools (#)	4	5	11	22
Affected Health Facilities (#)	3	5	10	17
Mapped Schools (#)				863
Mapped Health Facilities (#)				536

Table B-8 Impacts of hydropower facilities on cultural assets by scenario

Indicator (cumulative)	Existing	+ Under construction	+ 10,000 MW Program Plus	+ Prefeasibility/ reconnaissance
Installed Capacity (MW)	1,606	5,264	14,196	21,191
Affected Historical Sites (#)	7	10	21	38
Affected Historical Sites (%)	0.4	0.56	1.2	2.1
Mapped Historical Sites (#)				1776

assessment, neither are potential impacts on cultural heritage mentioned in the ESIAs for ongoing projects. On the other hand, local media did report potential impacts on religious sites for some of the planned projects in the near-term pipeline.

Impacts of Hydropower Facilities on Major Historical Sites.[47] The aim of this analysis is to examine the potential impact of hydropower facilities and their ancillary infrastructure on important cultural facilities, using a 2 km radius buffer around the dam/intake structure of each project (Table B-8). As Bhutan's religious and cultural heritage is very diverse and complex, it cannot easily be captured by spatial analysis. Thus, for the purpose of this study, only historical sites such as monuments, *Dzongs,* and museums are included.

Summary

Based on the geographical analysis, it is clear that the impacts from new hydropower development and additions to the transmission network compound for aquatic and terrestrial ecosystems and communities. While the increase in impacts appears proportional to the amount of new energy generated by the projects for some indicators (e.g., affected river stretches and free-flowing river stretches), some impacts show a disproportionate increase from one scenario to another. For example, a 50 percent increase in installed capacity from those sites in the prefeasibility/reconnaissance phase increases encroachment in protected areas by over 400 percent.

[47] See above.

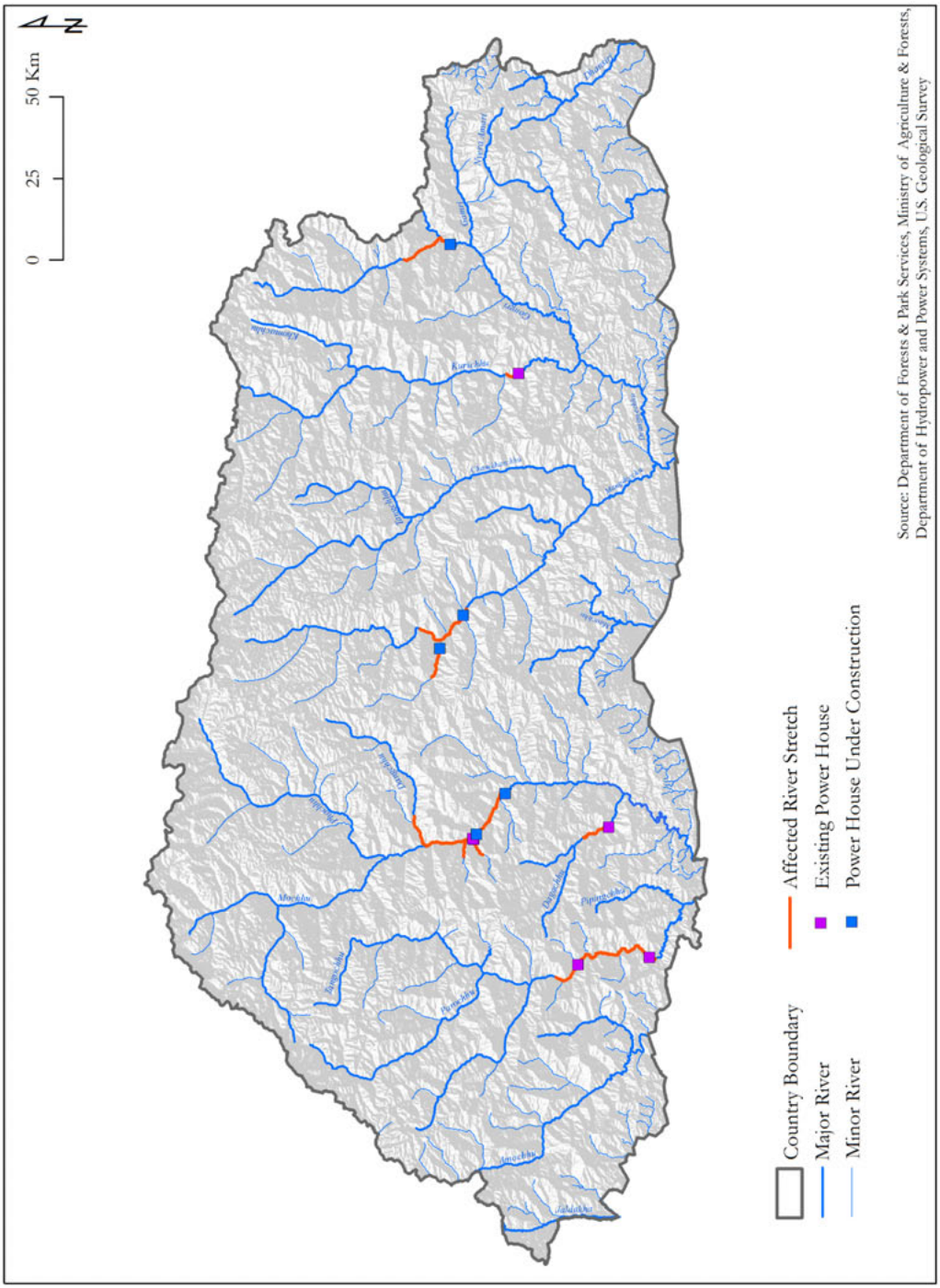


Figure B-1 **Affected river stretches for hydropower facilities, existing and under construction**

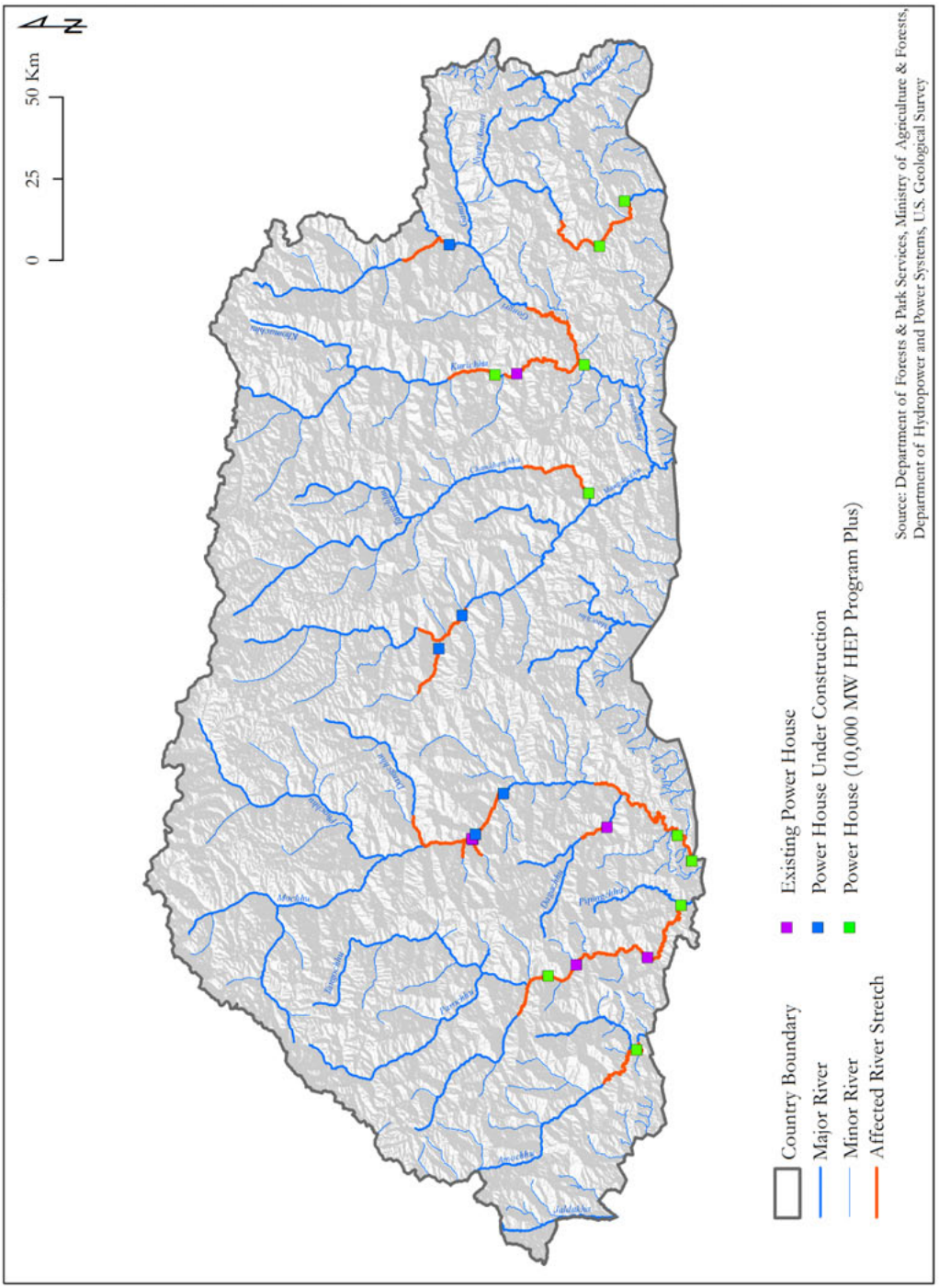


Figure B-2 Affected river stretches for hydropower facilities, up to 10,000 MW Program "Plus"

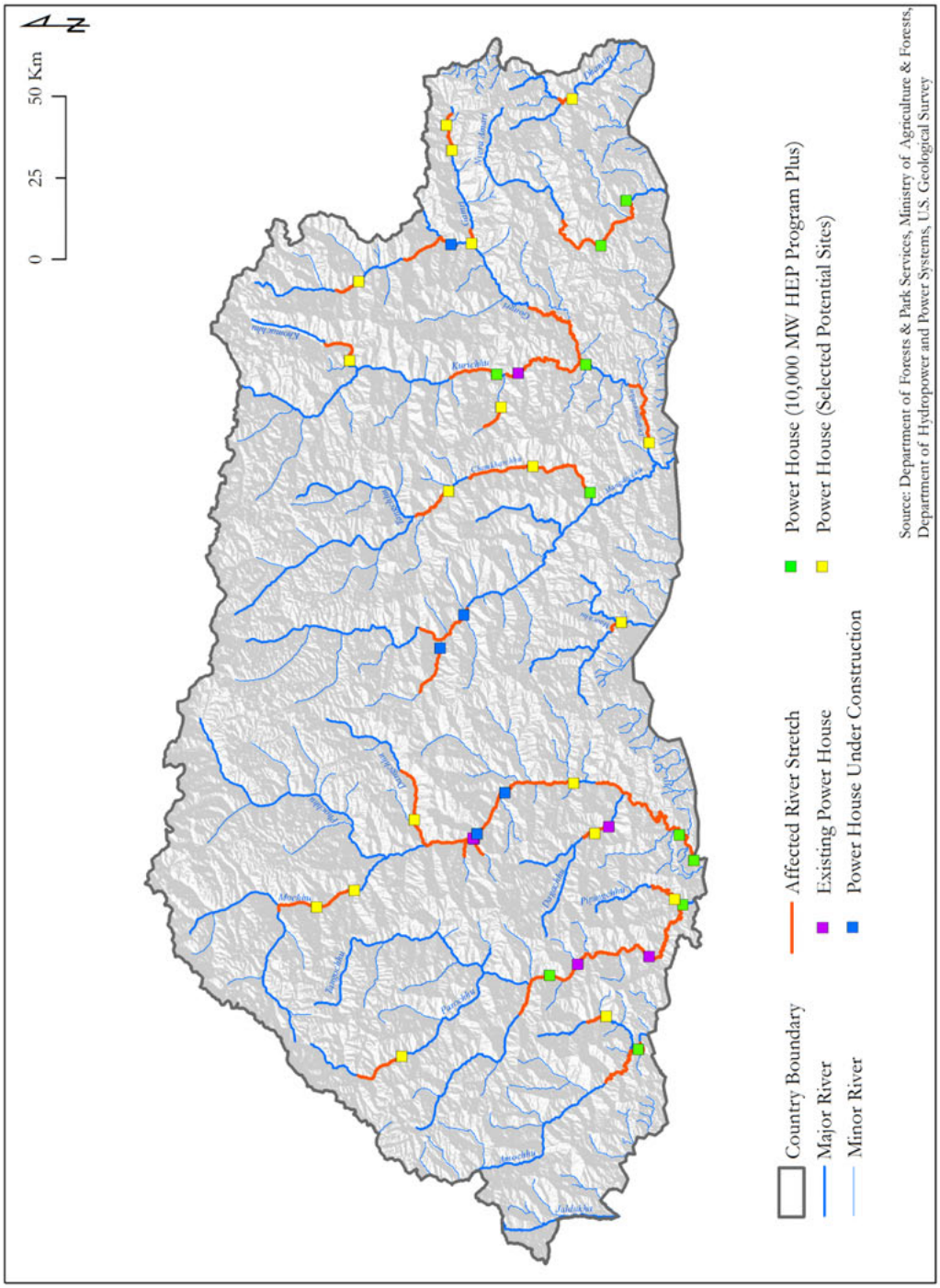


Figure B-3 Affected river stretches for hydropower facilities, up to 21,191 MW

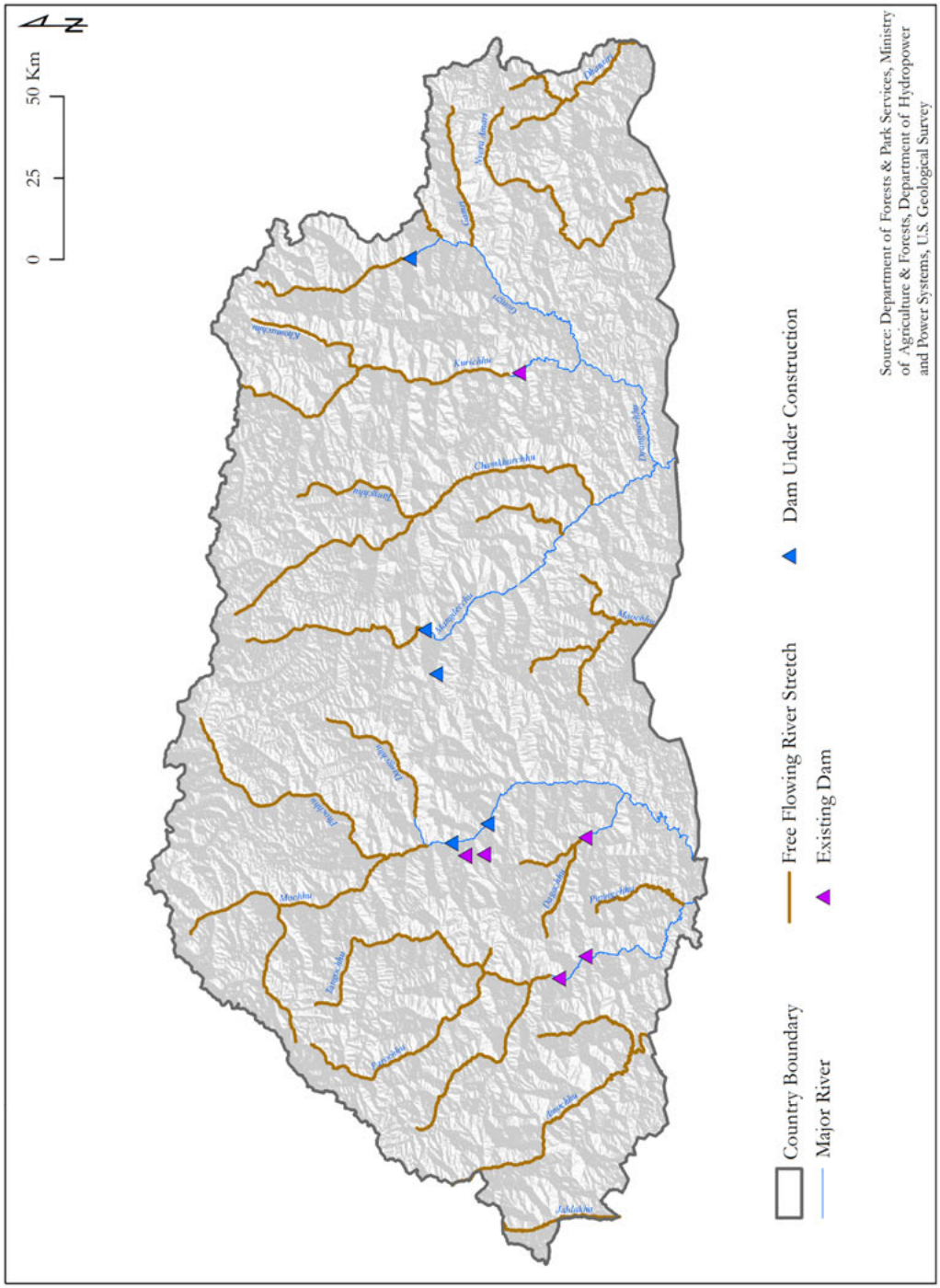


Figure B-4 Free-flowing river stretches for hydropower facilities, existing and under construction

Figure B-5 Free-flowing river stretches for hydropower facilities, up to 10,000 MW Program Plus

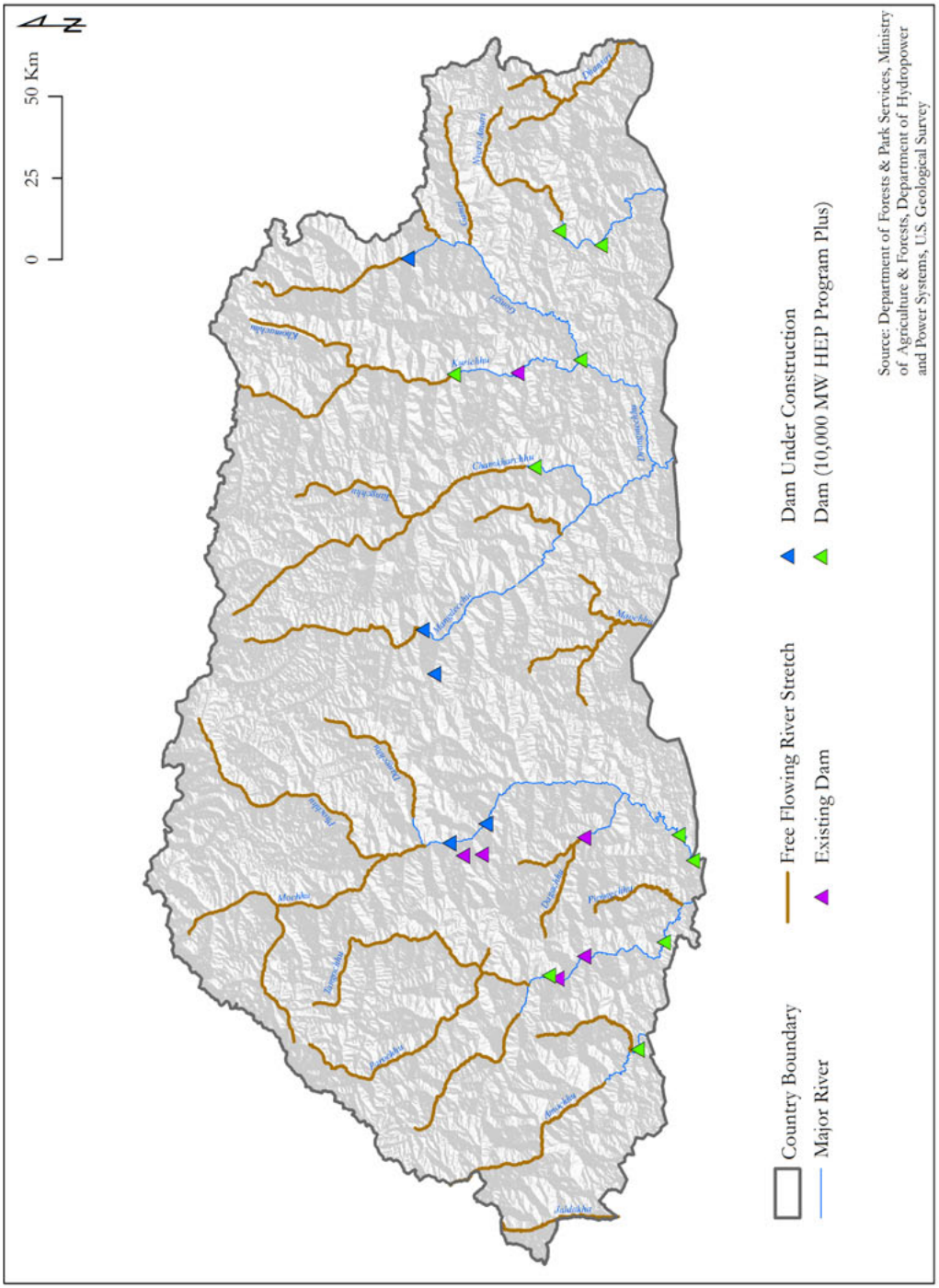
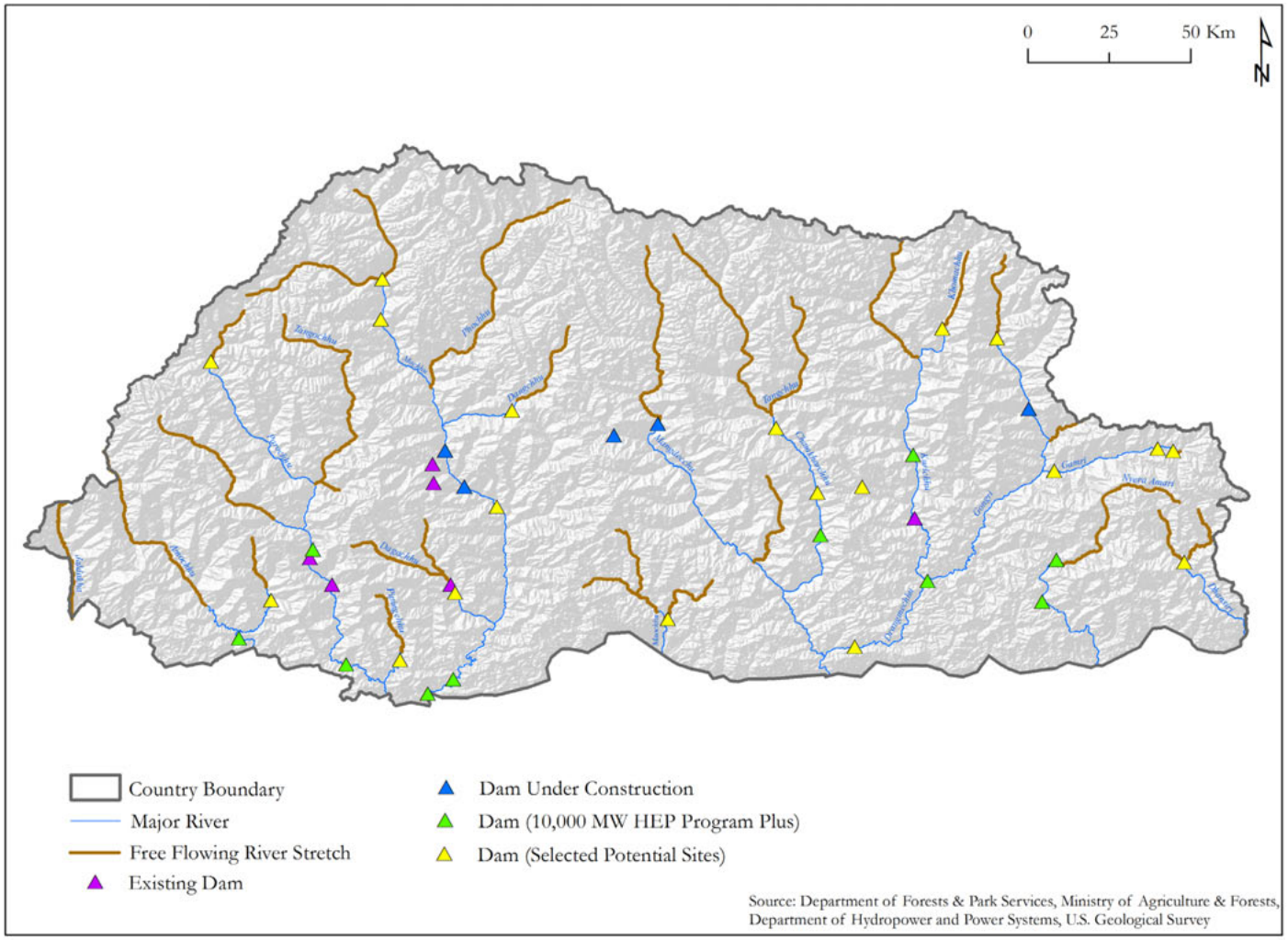


Figure B-6 Free-flowing river stretches for hydropower facilities, up to 21,191 MW



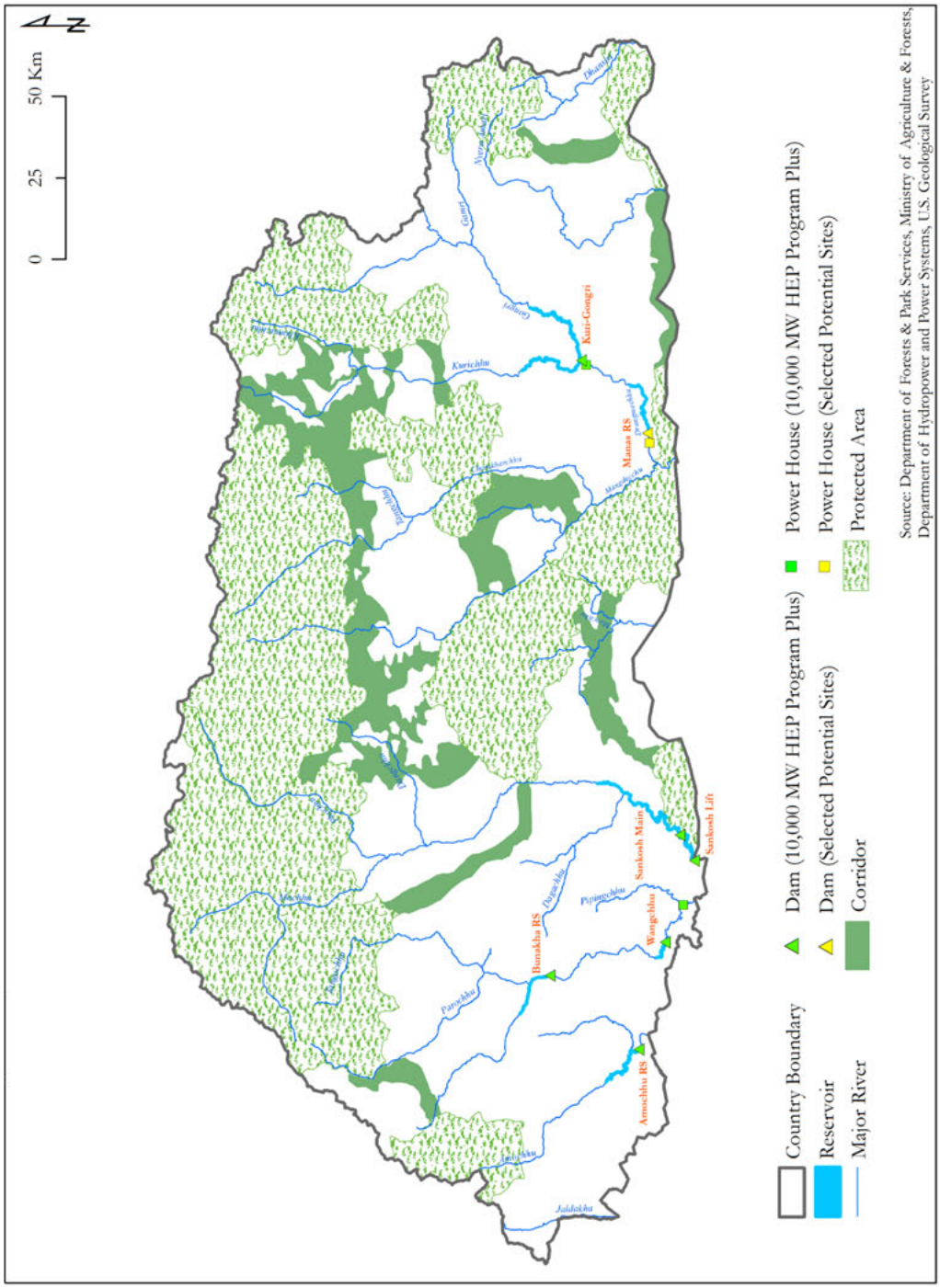


Figure B-7 Planned storage projects

Figure B-8 **Protected areas and corridors affected by hydropower facilities, existing and under construction**

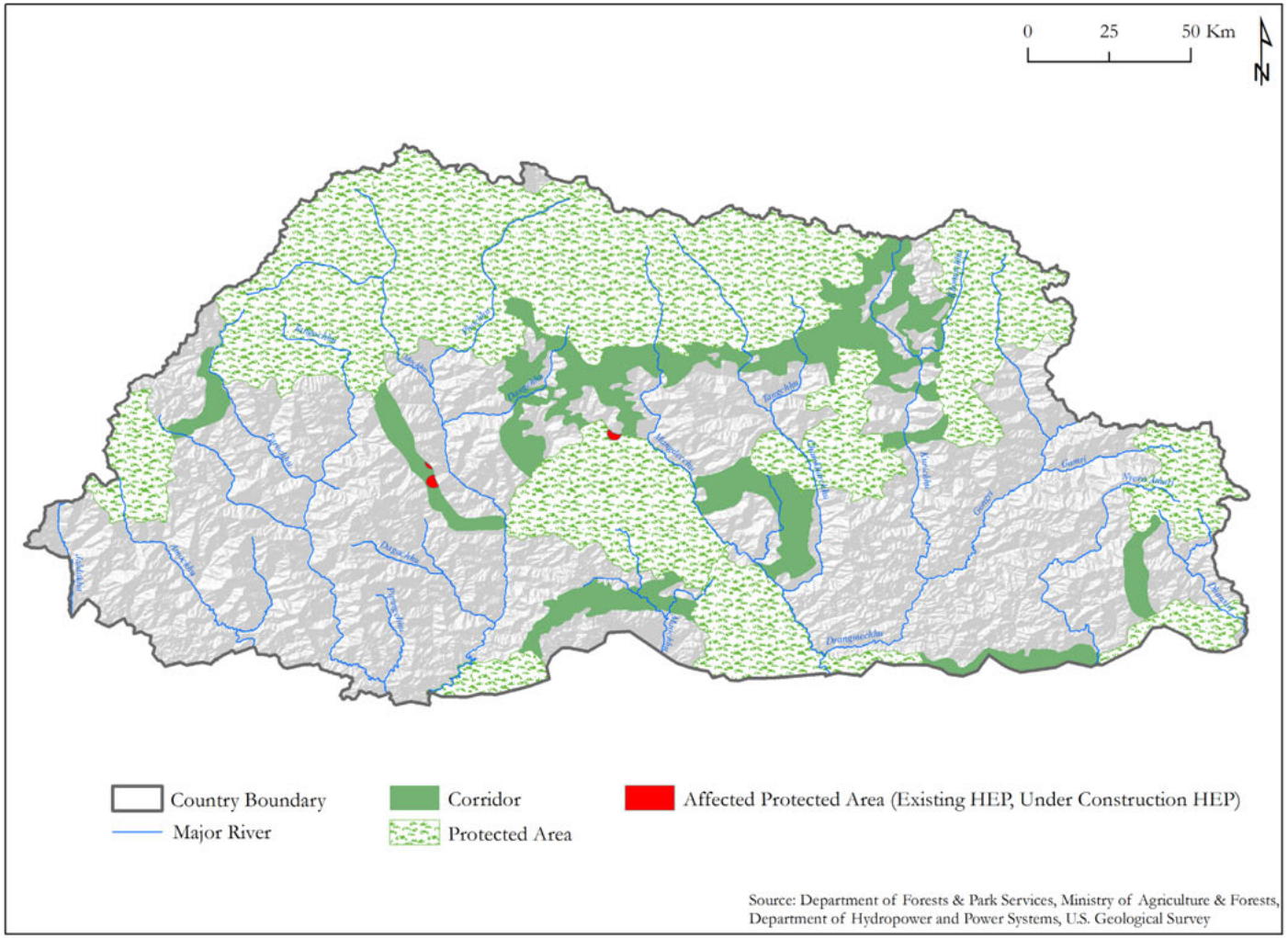


Figure B-9 **Protected areas and corridors affected by hydropower facilities, up to 10,000 MW Program Plus**

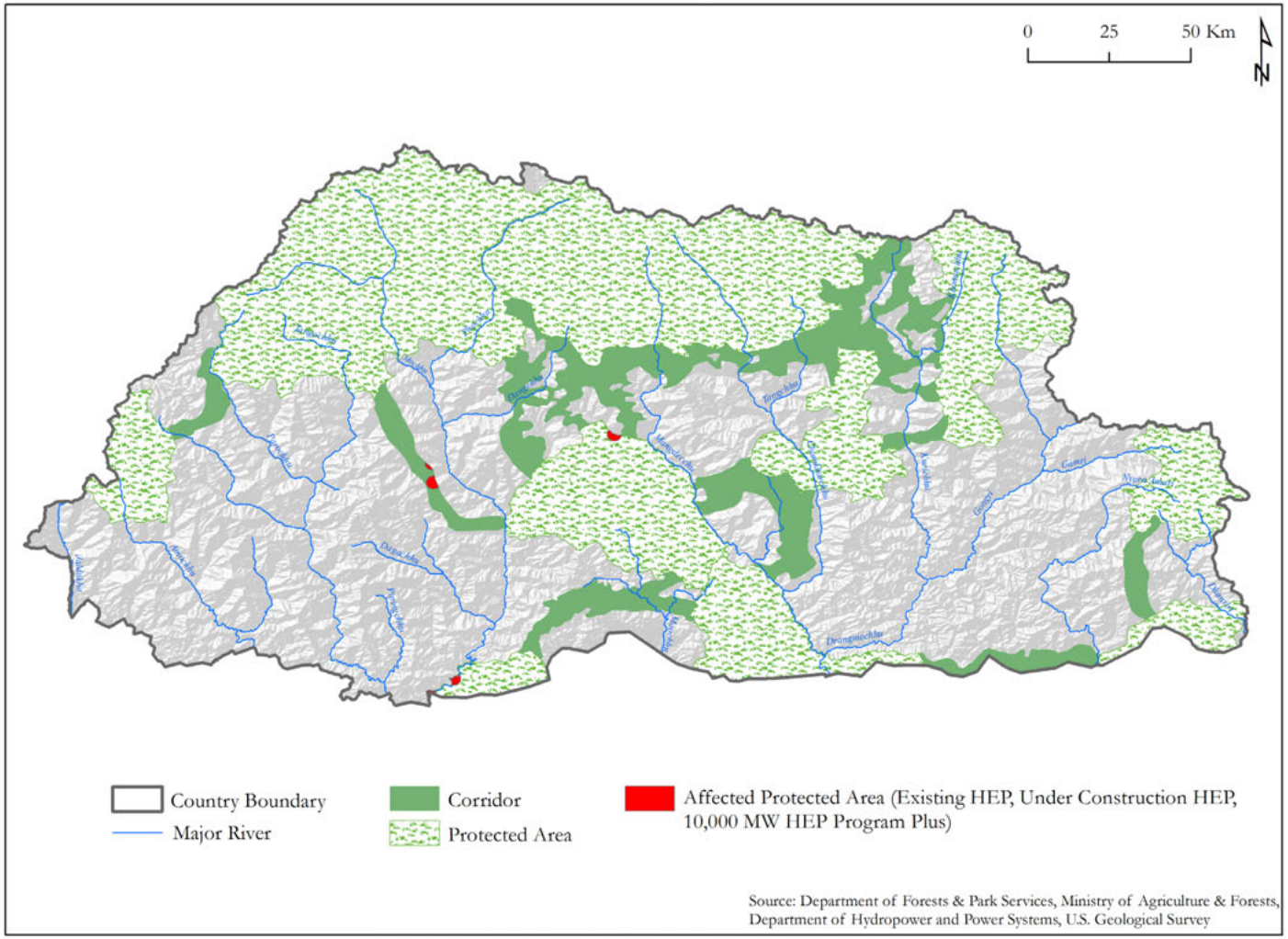
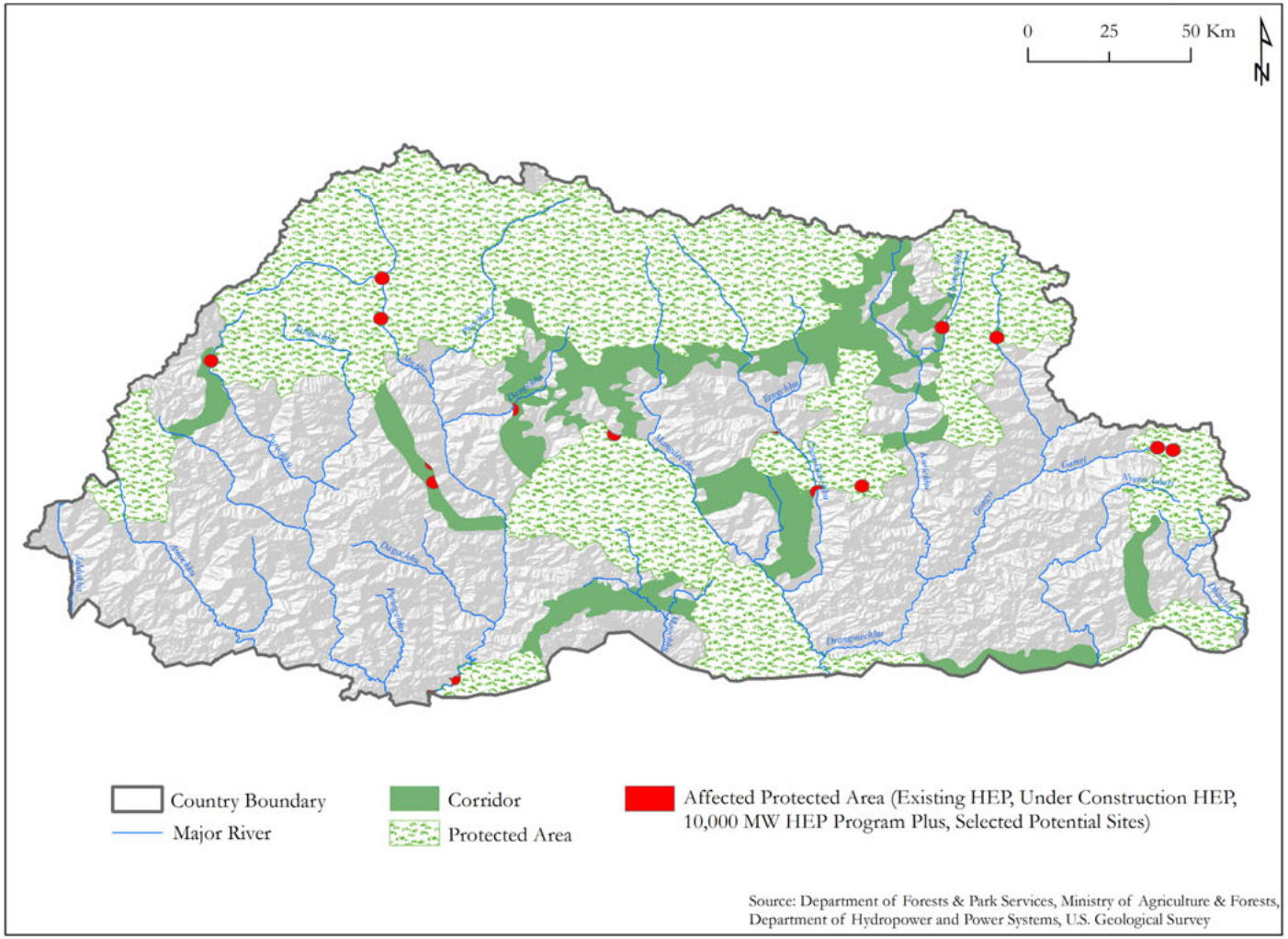


Figure B-10 **Protected areas and corridors affected by hydropower facilities, up to 21,191 MW**



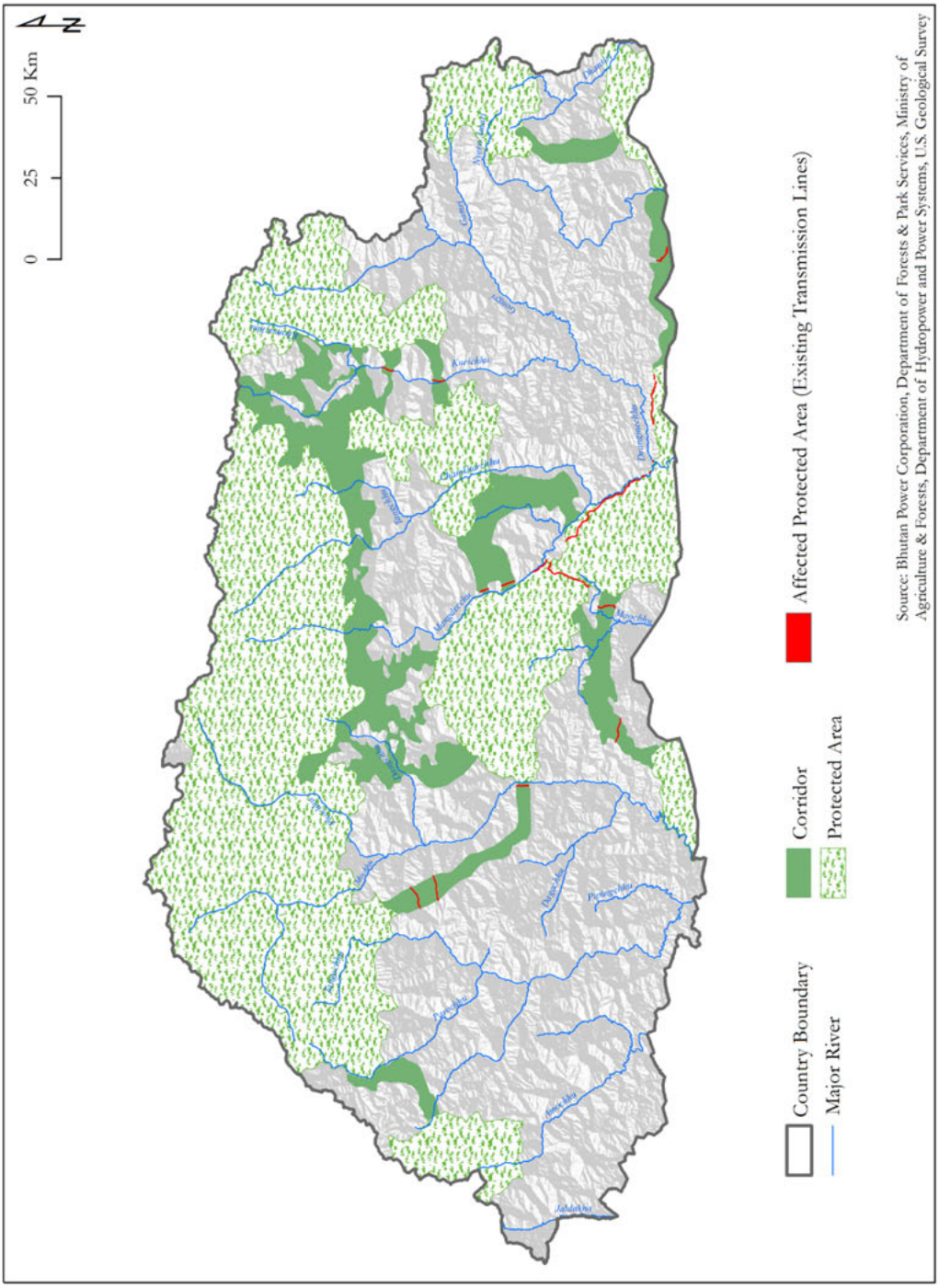


Figure B-11 Protected areas and corridors affected by existing transmission lines

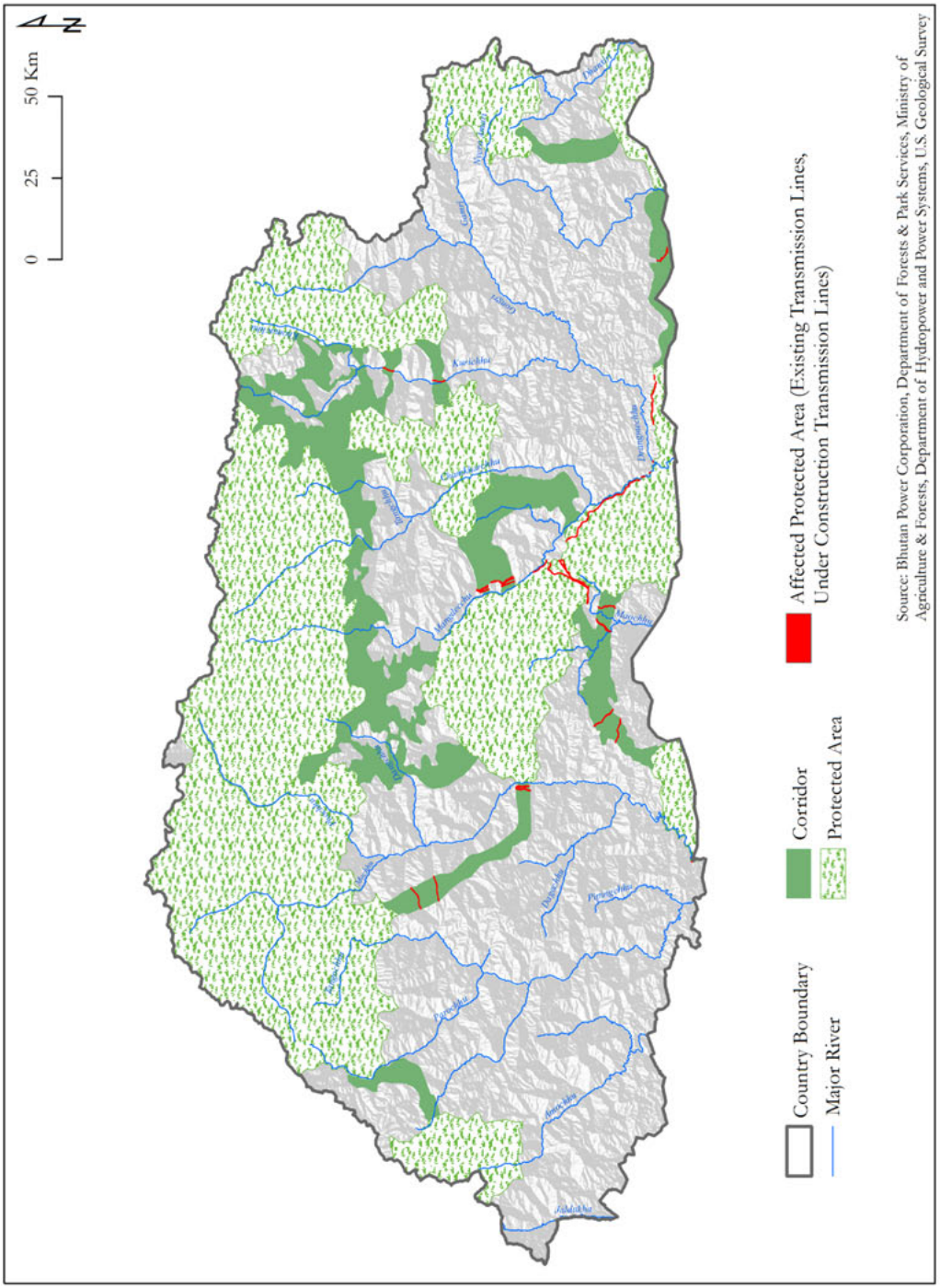


Figure B-12 Protected areas and corridors affected by transmission lines, existing and under construction

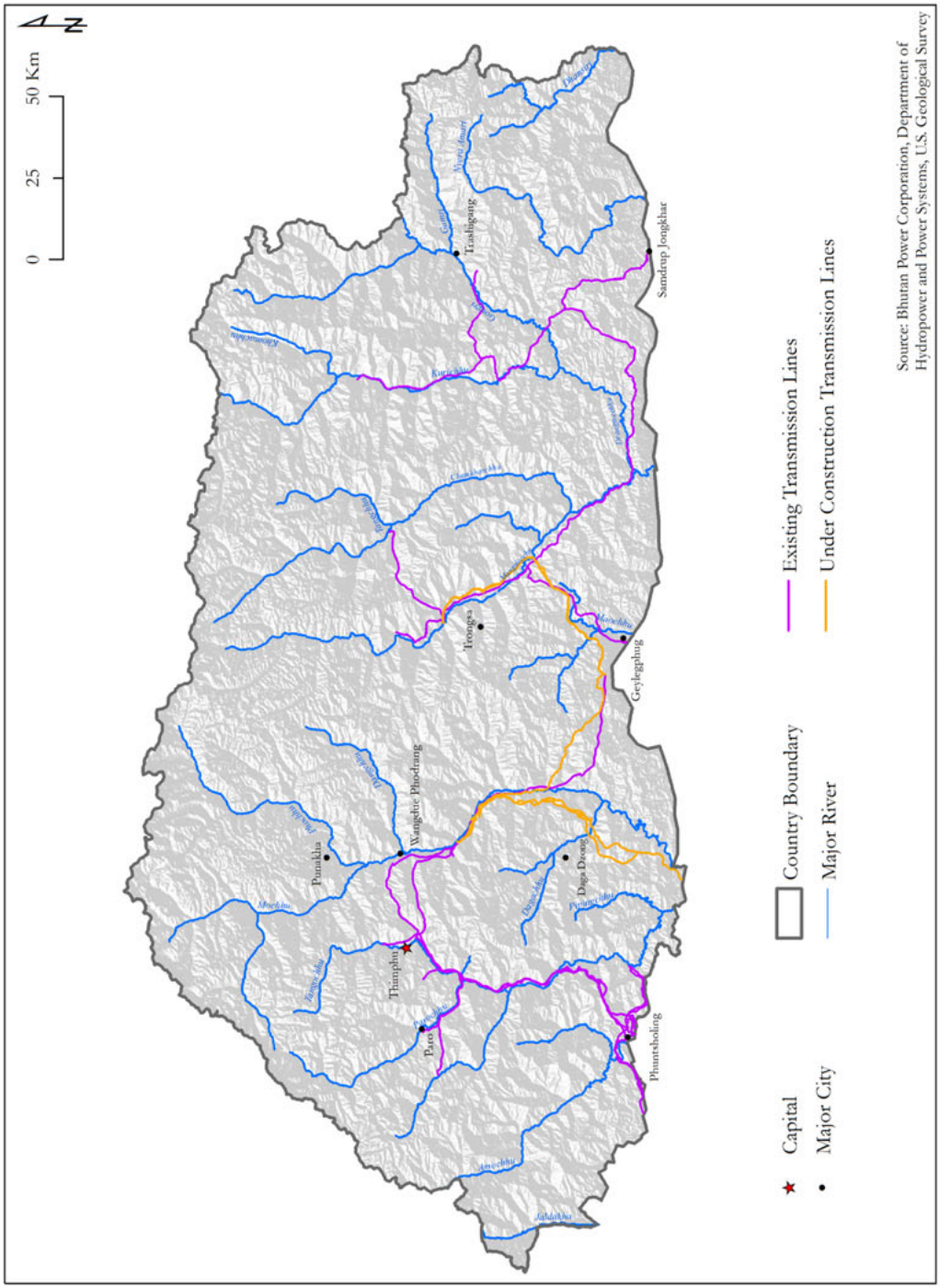


Figure B-13 Transmission lines, existing and under construction

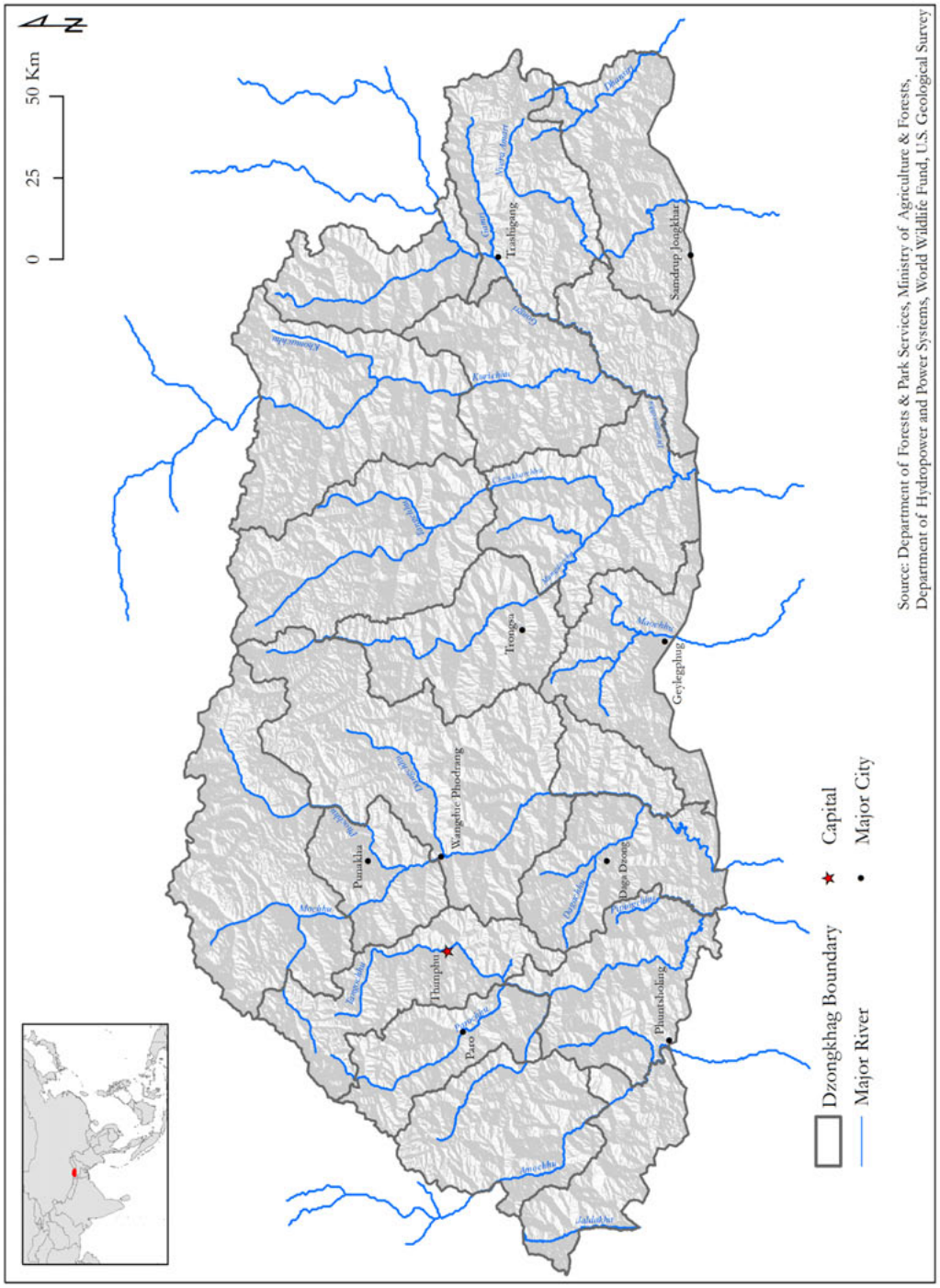


Figure B-14 Major rivers of Bhutan

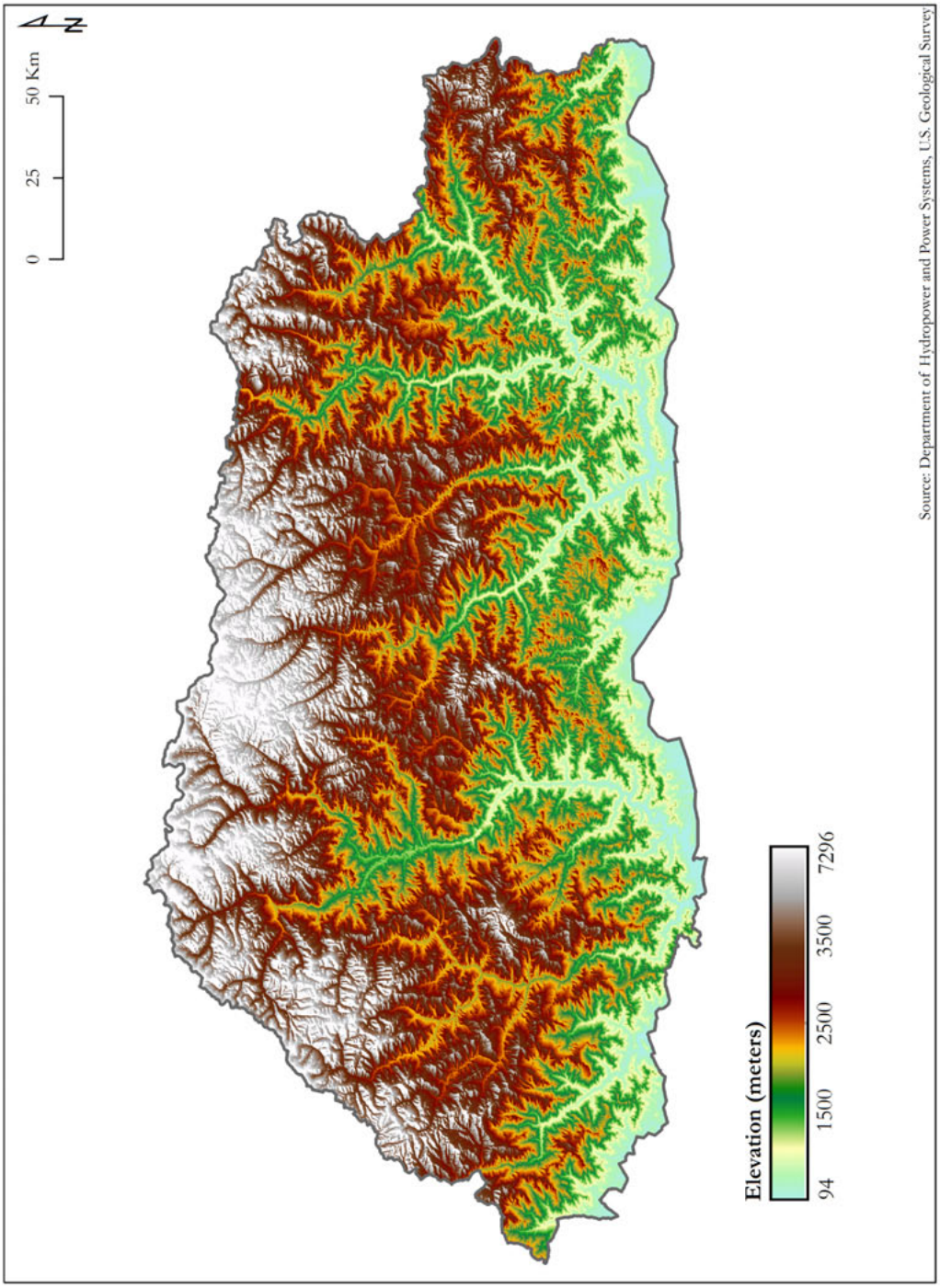


Figure B-15 Topography of Bhutan

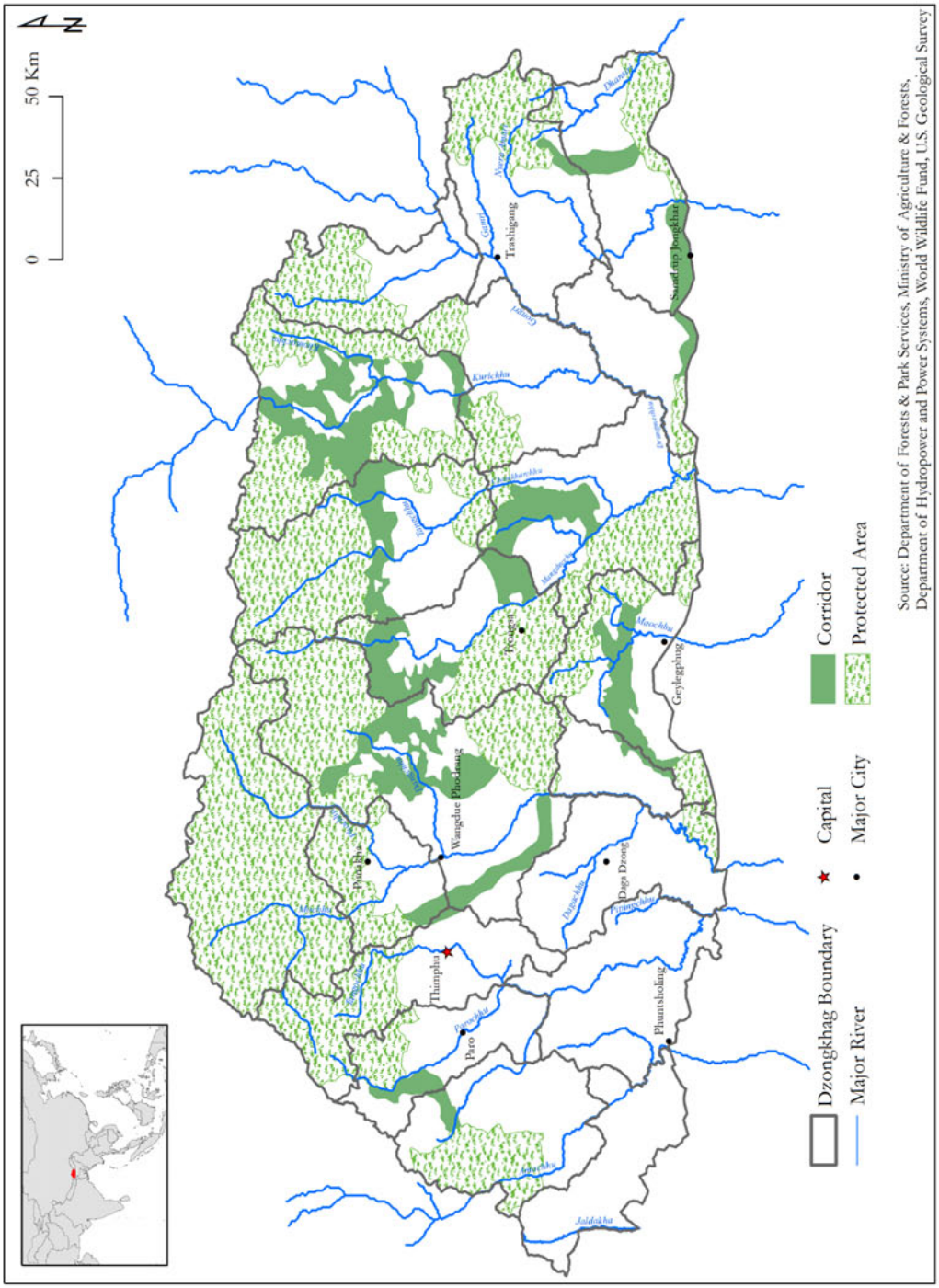


Figure B-16 Protected areas of Bhutan

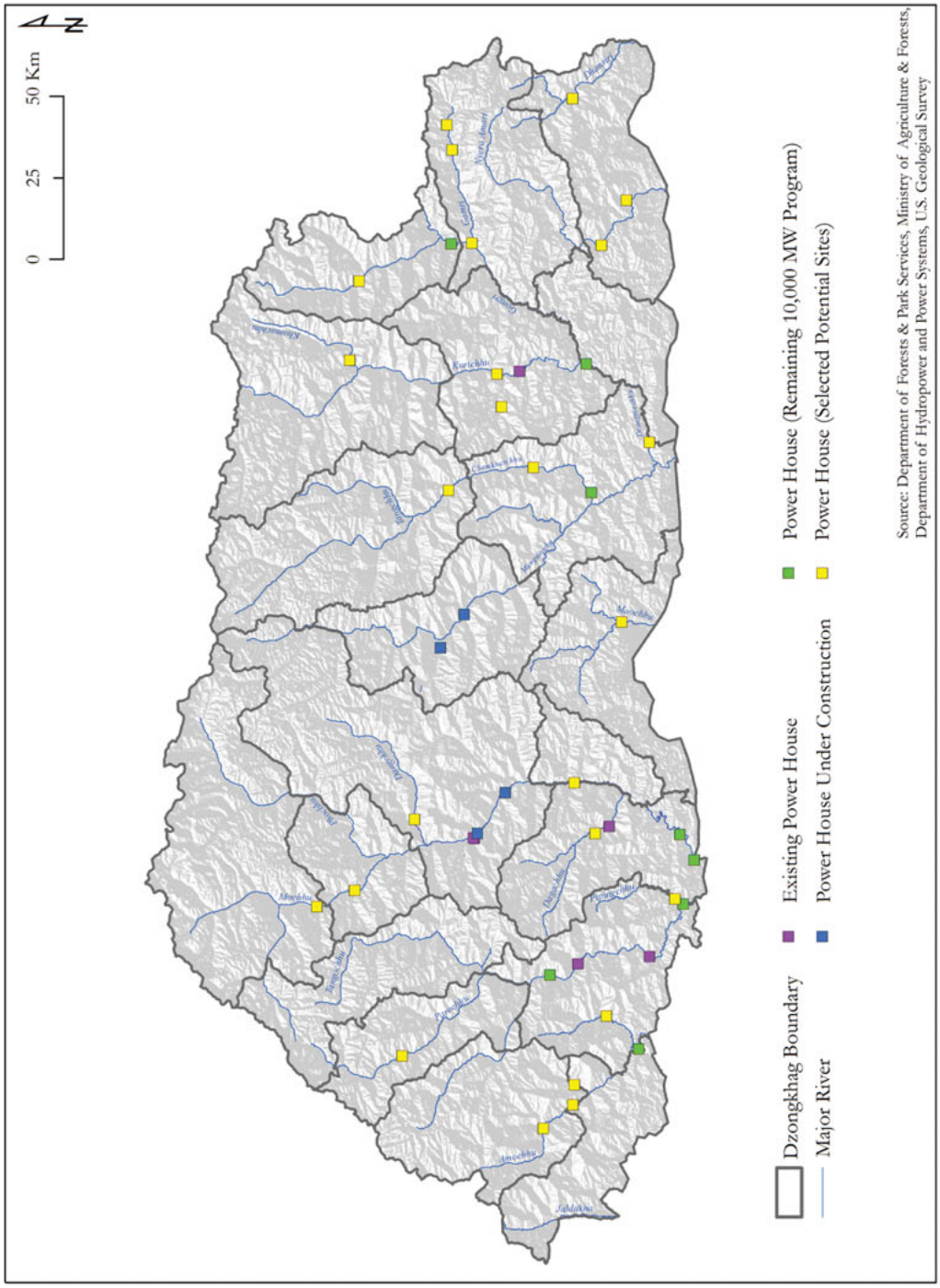


Figure B-17 All identified project sites with studies at least at reconnaissance level

Appendix C
Rapid Institutional Assessment for Environmental and Social Management of Hydropower

A targeted institutional assessment of the main organizations involved in E&S management of hydropower has been conducted. The scope of the study was restricted to the following institutions relevant to managing E&S issues in the hydropower sector: (i) the National Environment Commission (NEC); (b) the Gross National Happiness Commission (GNHC); (c) the Department of Hydropower and Power Systems (DHPS); and (d) the Druk Green Power Corporation (DGPC) Limited. The methodology used incorporated both secondary research and primary meetings. Secondary information, such as policies and regulations, was collected through the Internet and through conversations with people. The primary meetings were held with the above institutions in the periods Feb 13–17, 2016, and Mar 7–11, 2016, in Thimphu, Bhutan.

National Environment Commission (NEC)

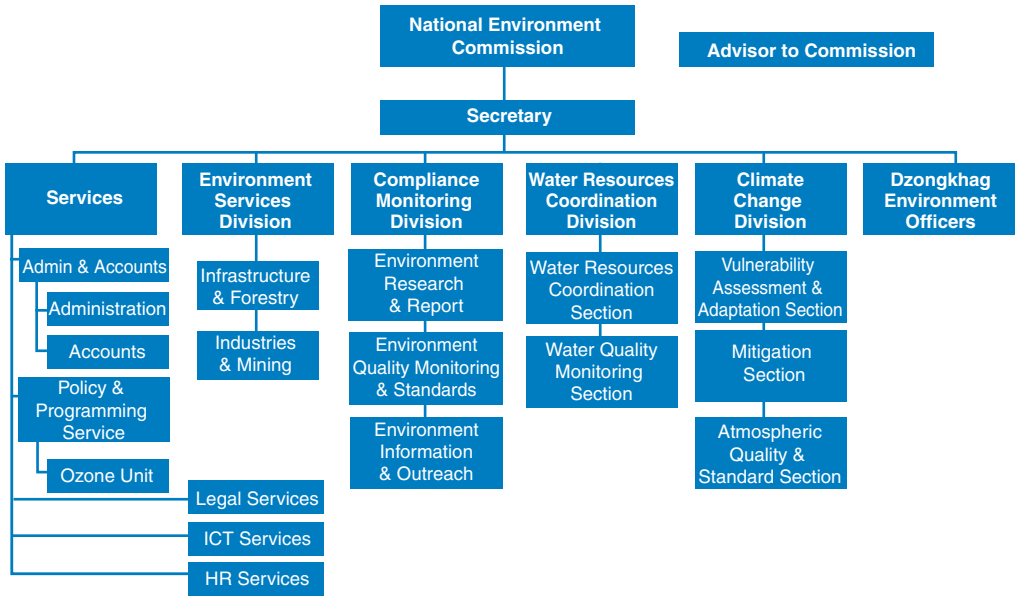
Existing situation

NEC includes the members of the Commission and the Secretariat. It is headed by a Secretary and includes the following Divisions: Administration and Finance, Policy and Programming Services, Legal Services, Human Resource Services, Environment Services, Compliance Monitoring, Water Resources, Climate Change, and ICT Services. Each *Dzongkhags* is assigned a *Dzongkhag* Environmental Officer (DEO), who falls under the respective DAs.

The Environmental Services and Compliance Monitoring Divisions are the divisions directly involved with the hydropower sector, and that is why these two divisions are the focus of this institutional assessment. The Water Resources Division is presently anchoring an IWRM study, which involves the hydropower sector indirectly. This study lies beyond the purview of this study. It should be pointed out that DEOs are also involved in compliance monitoring of hydropower projects if the latter are located in their own *Dzongkhag*. As this study focused on the NEC *Secretariat*, the role of the DEOs was not explicitly discussed.

Both the Environmental Services Division and the Compliance Monitoring Division

Figure C-1 Organizational chart for NEC



are staffed with a Head and four officers. All these officers have a sciences background. Each division has one senior officer, while the staff are Assistant Environmental Officers. Everyone agrees that the staff strength of these two Divisions lies below what the hydropower sector requires. What makes matters even worse is that these two divisions also have to cater to all the other economic sectors, for instance, industry, infrastructure (roads) and mining. Consequently, the shortage of staff is a major concern.

In accordance with the Environmental Act (2000), NECS is responsible for providing environmental clearance to all hydropower projects. In line with the requirements of the Regulation for the Environmental Clearance of Projects (2012), under the Act, the project proponent prepares the EIA following the procedures outlined. The NECS also issued an EA Guideline for the Hydropower Sector, one of six sector guidelines produced. These are intended to guide the project proponent on the process of obtaining environmental clearance for their projects. NEC's Environmental Services Division grants Environmental Clearance for the various EIAs of the hydropower projects.

Once the environmental clearance has been granted, the NECS has to ensure compliance with the provisions of the Act, Regulations, and conditions of the environmental clearance. The NEC Compliance Monitoring Division ensures compliance with the clearance conditions. Discussions revealed that the respective hydropower authorities—their Environmental Departments—generally send monthly reports (on compliance and daily environmental quality) and a comprehensive annual compliance. When NEC monitors compliance onsite, the above reports are used as the basis for monitoring. It was concluded that the hydropower authorities have a well-staffed Environment Department, for example, in Punatsangchhu II, the department has a staff of about 45. As a result, the quality of compliance monitoring is likely to be relatively strong, provided the Hydropower Authorities' staff are well-qualified.

RCSC's ongoing organizational development (OD) study of the NEC

Discussions revealed that the Royal Civil Services Commission (RCSC) is currently engaged in an OD study across as many as 67 agencies within the RGoB. The purpose of these

OD studies is to align the agency's work with its mandates. NEC was one of the agencies covered under this study. A Task Force was established within NEC to collect, collate, and deliberate on organizational issues.

One of the main conclusions of the study was that NEC was functioning both as a regulator and as a policy formulation and planning agency. Being called a Commission, its primary role was obviously intended to be policy formulation and planning. Therefore, very recently, it was proposed that NEC's regulatory role along with that of the Department of Forests be transferred to a separate regulatory authority. This proposal was put to the Cabinet. The Cabinet did not accept the proposal because it was considered inconsistent with the legislative inclusion, for example, NEPA and the Forest Acts. Transferring NEC's regulatory role to another, different institution would require the Forest Act to be amended first, and that is not readily done. In view of the Cabinet's decision, RCSC is now deliberating with the NECS on the best way to proceed with the organizational strengthening without dividing the current NECS into two separate organizations.

Further, the risk of a conflict of interest seems to be inherent in the organizational arrangements of the DEOs. While the DEOs are regulators, they report to the Dzongkhag administration and not to the NECS. Given this dual responsibility, the NECS does not have control over the day-to-day activities of the DEOs, even though the DEOs' role is to regulate. The RCSC is presently deliberating with the NECS in an attempt to resolve the DEOs' potential conflict of interests.

The establishment of regional NEC offices has been considered, motivated by the desire to improve the efficiency and effectiveness of the NEC in dealing with clearances and compliance. While the discussions on this point did not reveal why this step had not been taken, it is safe to assume that a lack of funds or budgetary constraints was one of the reasons.

Possible areas for strengthening identified

Separating the "regulator" from "policy-making": Ideally, the institution responsible for policy formulation and coordination should be different from the regulator. However, in the case of Bhutan, given its small population and limited geography, separating the NEC into two institutions may not be required. On the other hand, creating separate units for policy formulation and coordination and for the regulatory function, within NEC, could be an option. Currently there is a lack of manpower to provide clearance and compliance services. Nevertheless, the officials involved in clearance and compliance are to a large extent also the ones conducting studies such as those pertaining to e-flows. This has led to the staff being overloaded, and potentially less focused on their core regulatory function. It is therefore vitally important to somehow separate NEC's policy formulating function from its regulatory function: the staff assigned to each function should not be shared with the other function.

Collaborating with DHPS on policy, planning, and coordination: All policies related to the hydropower sector have a direct bearing on the environmental conditions and the volume of hydropower that can be generated. Therefore, all policies should to the extent possible be developed jointly between the DHPS and NEC. For instance, the subject of e-flows is important for the environment but also important for generating hydropower. As the policies to be developed will defining a compromise path, both the policy units of DHPS and NEC should be involved. Policies need to be formulated on, among other things, IWRM, catchment area treatment, sediment management, and use of fish ladders. It is preferable to establish the practice of working together on policy, planning, and coordination.

Building social development expertise in the NEC: The EIA process in the case of hydropower projects involves addressing baseline data, potential impacts, and mitigation measures pertaining to social development issues. The latter include specific concerns of project-affected persons, such as compensation for land lost in accordance with National Land Commission (NLC) norms for resettlement and livelihood/income restoration. In reviewing and deciding on an application for environmental clearance, staff capable of dealing with social development issues is required. In addition, to monitor compliance, social development staff capacity is required. Presently, NEC is regulating social development in hydropower projects without having any expertise in specific areas such as land compensation and resettlement, In fact, addressing such specific social development issues goes beyond NEC's regulatory mandate. Thus, NEC's capacity to deal with social development should be strengthened by either recruiting staff with the relevant background and/or increasing collaboration with other government organizations that cover social development issues.

Having dedicated staff for the hydropower sector: There is a strong case for increasing the number of dedicated staff for the hydropower sector to be able to perform the clearance and compliance functions efficiently and timely. As to the clearance function, at least two dedicated staff are needed to work on the five projects that are already in various stages of construction and the pipeline projects. At least two dedicated staff are likewise needed for the compliance function, more specifically, to address the projects already under operation and those under construction for which clearance has already been obtained. These dedicated staff should be responsible for clearance and compliance matters related to both power generation and power transmission projects in the hydropower sector. To enhance effectiveness in the clearance and compliance functions, the dedicated staff in the respective divisions should have a mixed background—with a civil engineering, environmental sciences, and social sciences component. Given the possible constraints to identifying and hiring suitable staff for these positions, the seconding of staff already working in the hydropower sector to NEC could be an option. In this way, the backlog could be cleared, something that is urgently needed.

Institutionalizing the practice of sharing staff for clearance and compliance purposes: In the hydropower sector, the lessons from compliance monitoring have to be considered and appropriately addressed in the clearance process. Given this need, it is important that the staffs be constantly rotated between the clearance and compliance functions. If a separate unit is created to deal specifically with hydropower, that unit's staff could work together to provide clearances and monitor compliance.

Enhancing Bhutan's environmental baseline information: Environmental baseline data are required for conducting studies relevant to the EIA. It is generally accepted that the quality of data on flora, fauna, and ecosystems in Bhutan is weak, and needs to be improved substantially. Doing a countrywide environmental baseline study would be expensive and time-consuming. While such a countrywide study should be planned for the medium term, NEC should for the time being collect and collate environmental baseline data in a structured and systematic manner from various sources. This should all be done with the help of various NGOs and research organizations such as the World Wildlife Fund for Nature (WWF) Bhutan Program and the Royal Society for the Protection of Nature (RSPN). In addition, reliable environmental data collected as part of past EIA studies should likewise be collated and used in current and future EIA studies.

Establishing the EAAB: The Regulation for the Environmental Clearance of Projects

(2002) includes a provision for establishing the Environmental Assessment Advisory Board (EAAB). The Regulation addresses the composition of the Board, whose members may serve in their official or individual capacity. Rules and procedures for the EAAB's activities should also be developed and adopted. It is believed that EIA reports should be presented to the EAAB following their in-depth technical review by the Environmental Services Division. Environmental clearances should only be granted On the Board's recommendation,. The current procedures and practices on environmental clearance should be changed to reflect the EAAB's extended role. This Board should also serve as a forum for raising and addressing issues regarding the overall EA procedure itself. NEC recently (July 2015) introduced an application fee—Nu 1,000 per MW—for processing an EIA report for the hydropower sector. These fees could be used to develop a roster of experts to support the Board, and pay them a suitable honorarium to ensure a sincere effort in the review process on their part.

Streamlining and improving the environmental clearance process: Discussions with the DHPS and DGPC revealed that the project proponent and the relevant hydropower authority spend considerable time and effort in obtaining environmental clearance. Several measures could be considered to streamline the process:

- It would be useful for NEC to develop a guidance document that outlines the indicative timeline for the various stages of the environmental clearance process in a flow chart, based on an ideal case. The timeline for each individual process stage—preparing the EIA document, conducting consultations at the *Gewog* level, obtaining clearance from the Department of Forest & Parks, obtaining clearance from the DA, and finally obtaining NEC clearance—should be included. Such a guidance document would enhance transparency, help the project proponent/ hydropower authority with their planning, and reduce unrealistic expectations. It would also establish a benchmark that would allow to determine the extent of delays in providing clearance, and identify the cause causes for these delays.
- While the project proponent should strive to submit a single environmental clearance application, it should be possible to make changes to the activities specified in the original application, as these are inevitable in the context of hydropower projects. Special provisions could include permission to consider an expected clearance, after submission of the EIA application, also applicable to certain types of changes subsequently made to the planned activities. The purpose of such special provisions would be to reduce the time needed for obtaining environmental clearances, as these can lead to implementation delays and financial problems.
- When it comes to changes/modifications to a project that has already secured environmental clearance, discussions revealed anything currently being done during a site/field visit by NECS staff, could also be done by a DEOs. However, in this context, the fact that requiring *NECS* staff to make these visits causes significant delays (given current staff constraints) was again highlighted. These one-day visits could easily be made by the relevant DEO. Current procedures have to be slightly changed to make it easier to introduce changes in the planned activities for projects that have already obtained clearance.
- Hydropower projects are complex in terms of their technical, financial, and operational requirements. Once the detailed designs have been finalized, the EIA is prepared, submitted, and finally a clearance application submitted. Once clearance is obtained,

project delays are very likely due to financial and operational issues. If the NEC clearance is valid for two years, the environmental clearance may have to be obtained a second time, even when the detailed design itself has not changed at all. Moreover, the unavoidable bureaucratic delays have to be reckoned with. In view of these factors, it may be advisable to give environmental clearances a 5-year validity when required for hydropower projects.

- Discussions revealed that the plan had been to turn the environmental clearance process into an online process but this has not yet been done. The intention is to have a Web-based process for submitting the EIA documents as part of the environmental clearance application. Besides facilitating the application process, the online procedure would give information on the current status of an application and allow lists of the hydropower projects for which clearance has been granted/denied to be generated. Once the clearance process has been established online, this could be extended to include compliance monitoring as well. To this end, the relevant parties would be asked to upload specific information on the respective hydropower projects.

Improving the environmental compliance process: Discussions revealed that the compliance process is not streamlined and that reporting paths are unclear. The following potential improvements have been identified:

- DEOs are involved in and/or support the monitoring of hydropower projects' compliance. However, the DEOs administratively report to the DA and not to NEC. Even though their activities pertain largely to those of a regulator, they are mapped to the DA, which implements development activities. Therefore, the needs of the DA rather than those of the NECS drive their day-to-day priorities. Considering that NEC has a significant staff shortage, mapping the DEOs to the DA has further reduced the manpower available for environmental regulation. Thus, DEOs should be instructed to report directly to NEC, even though they are based in *Dzongkhags*.
- Discussions revealed that the DEOs receive about 25 clearance requests per week for sectors in which NEC has devolved clearance. It is virtually impossible for DEOs to visit each of the sites, as required by the Act and regulations. This is particularly difficult because many sites have to be visited on foot. As a result, there is a huge backlog of clearances, leaving the DEOs no time to monitor the compliance of hydropower projects.
- Discussions revealed that the Act contains provisions for conducting environmental audits. However, these provisions have not been enforced. NEC should consider mandating an environmental audit, prior to the closure of the project construction activities, to be conducted by an independent, third party, in accordance with a guideline that NEC should develop. Following the audit, the project proponent should address the nonconformances identified and produce a corrective action report. When submitting the final compliance report to NEC, the inclusion of an audit report along with an audit follow-up report should be mandatory.
- The BEA has an Environmental Officer who is also involved in monitoring compliance with the environmental provisions of the Electricity Act, which is linked to the national environmental acts and regulations. The compliance role of this Environmental Officer needs to be integrated with that of NEC. This is important to ensure that NEC and BEA don't give conflicting directions related to compliance to the project proponent or Hydropower Authority.

Department of Hydropower and Power Systems (DHPS)

Existing situation

Within the DHPS, *environmental* issues are addressed by the Climate Change and CDM Cell (under the Planning & Coordination Division) and the Socio-Environmental Section (under the Hydropower Development Division). *Social* issues are only addressed only by the Socio-Environmental Section. Discussions revealed that it has recently been decided to revise the organizational structure so that all E&S issues will in future be dealt with by one unit under the Hydropower Development Division. This decision has yet to be implemented.

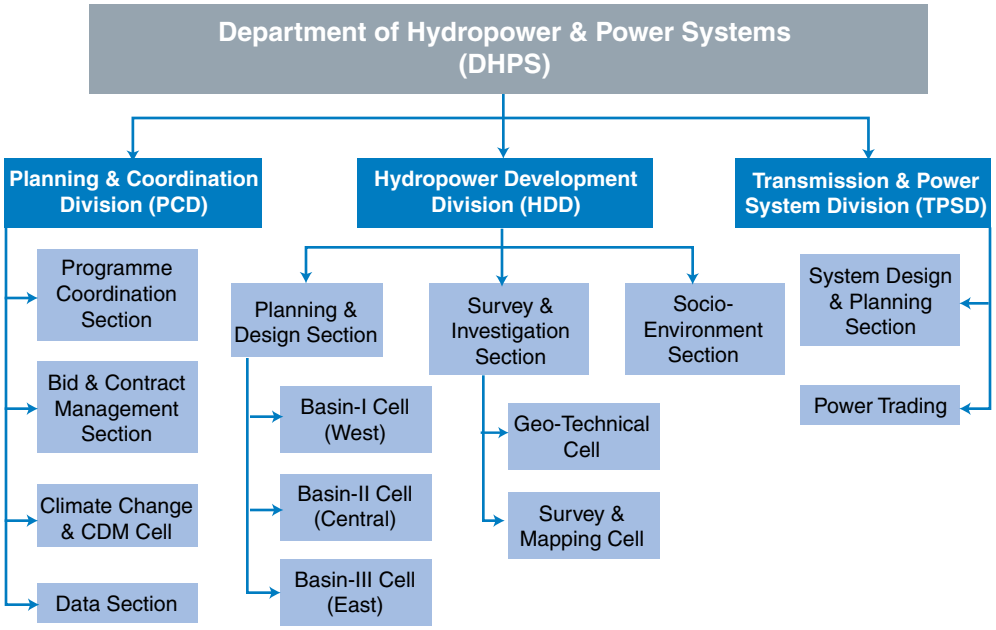
Presently, there is no separate staff earmarked to either the Climate Change and CDM Cell, or the Socio-Environmental Section. A pool of staff are managing the E&S issues as a part of the other issues. Very limited formal training and capacity building has been done. Only one staff member has had training, on Social Impact Assessments. Staff members have been managing their E&S activities through self-training and on-the-job training.

With the creation of a new unit in the revised structure, staffing for it has been proposed under the current five-year plan. This includes one engineer and one environmental engineer/officer. While this has been agreed in principle, the staff has yet to be appointed. Discussions revealed that separate TORs for this new unit have not yet been developed.

Based on discussions, the role of the DHPS is understood to be the following:

- To obtain approval from the RGoB for the various hydropower projects being planned. Considering that about 76 projects are presently in the pipeline or under consideration for development, this will remain a prominent role for the DHPS.
- To provide facilitation support to consultants who produce DPRs for hydropower projects. As part of the DPR preparation, EA studies are also prepared. These include EIA documents—EMP, social assessments, and Resettlement Action Plan (RAP). The DHPS provided such facilitation support to the Punatsangchhu-I and Kholongchhu

Figure C-2 Organizational chart for DHPS



hydropower projects all the way to obtaining NEC clearance.

- To organize a stakeholder discussion on the draft EIA with all the relevant line departments in order to collect inputs prior to its finalization.
- To coordinate and liaise with the other line departments, for example, the Department of Forests & National Parks and the Department of Culture and Department of Roads, to obtain their no-objection, which is a requirement for the NECS to provide environmental clearance.
- To liaise with the NECS until the formation of the independent Hydropower Authority on matters related to obtaining environmental clearance from NEC.
- To hand over the roles and responsibilities of managing E&S issues pertaining to the project to the Hydropower Authority once it has been established. For instance, in the case of the Punatsangchhu-II and Mangdechhu Hydroelectric Power Projects, the DHPS handed over the responsibility to the respective Hydropower Authorities once they had been established.
- To support the Hydropower Authority on any issues that may arise, for instance, disputes regarding compensation, and that require resolution at higher levels within the RGoB.
- To advise on E&S issues in the context of policy formulation and coordination as and when required.
- To coordinate all activities pertaining to registering hydropower projects under the CDM mechanism and also follow up on obtaining carbon credits for the RGoB.

At present, there is a Terms of Reference for the DHPS role as a whole, but not specifically on its role in managing E&S issues.

Identified possible areas for strengthening

Focusing more on policy formulation, planning and coordination: E&S unit of DHPS should focus more on management at the policy level. The subject of sustainable hydropower—the DHPS mission—requires much greater integration on optimal water resource use, conservation of forests, preservation of river eco-systems, community health and other infrastructure development. Developing an integrated approach requires a policy framework that includes considerations from many other line departments, for example, the Ministry of Agriculture & Forests and Ministry of Works and Human Settlements. As the DHPS mandate is solely on hydropower, greater depth on policy formulation, planning and coordination is achievable here than with the NEC, which has a mandate across all economic sectors. Further, the E&S unit of DHPS should also look at developing guidelines that help in policy coordination and implementation. For instance, establishing a guideline on EHS during hydropower construction or resettlement guideline for hydropower projects will lead to easing and streamlining the preparation of the EIA documents, as well as implementation. Having such guidelines and / or codes will establish how hydropower projects are to be implemented and operated within Bhutan.

Leading/co-owning all hydropower studies: The Socio-Environmental Section of the DHPS should be actively involved and engaged in all studies and initiatives pertaining to hydropower. The Unit should be co-owners of these studies and not limit itself to providing inputs to studies anchored in other agencies, for instance, the ongoing e-flows study being done by NEC with Austrian aid and the integrated water resources management being done by NEC as a part of activities under the Water Act. The former determines how much power can be

produced, whereas the latter is highly relevant for catchment area treatment, which is linked to sediment flows that could have a direct bearing on the power generation. Greater involvement—to the extent of co-owning—in all hydropower studies should become the norm.

Building capacity of the Socio-Environmental Section: The Socio-Environmental Section of the DHPS should strengthen its technical capacity to be able to review E&S documents. Such a technical review would provide value added to the DPR Consultants, who are responsible for preparing the E&S documents. The DPR Consultants may have the required technical E&S expertise but not necessarily the local knowledge. Such added expertise through the Socio-Environmental Section would help improve the quality of the project documentation prepared by consultants. The current quality of E&S documentation is generally regarded as weak. The lack of capacity in the DHPS to contribute to the E&S documentation will be addressed. Subsequently, the DHPS may itself engage DPR consultants. Building this technical capacity will aid in the selection of suitable DPR consultants.

The Socio-Environmental Section of the DHPS should develop its capacity to conduct the strategic environmental assessment of the Hydropower Master Plan with support and guidance of the NECS. In the medium term, the Socio-Environmental Section of the DHPS should develop a mechanism to collect data and store them in a database of key environmental parameters, for example, environmental flows and sediment levels, of each of its hydropower projects on a periodic basis. These environmental parameters are particularly important because they have a direct bearing on the hydropower generation in each individual project and in Bhutan as a whole.

To build the capacity in a short time frame, the E&S Unit should consider a multipronged approach: (i) exposure visits to other hydropower authorities that are recognized to managing their E&S issues effectively and also their national/provincial governments; (ii) in-house training by external resource persons on different E&S aspects that should be considered in policy formulation; and (iii) seconding staff to the various Hydropower Authorities of projects that are under construction or operational.

Developing multidisciplinary expertise in the Socio-Environmental Section: At the DHPS, the Socio-Environmental Section will require expertise from different disciplines, as promoting hydropower requires multidisciplinary skills. While the Socio-Environmental Section will definitely need representation from civil and environmental engineers, staff with background in the physical sciences, social sciences, and safety management will be required. The engineers will be responsible for integrating the environmental requirements in the contract documents and ensuring these are implemented; the environmental scientists will be overseeing the monitoring of environmental parameters, evaluating environmental impacts, and ensuring appropriate management; and the safety manager will assume responsibility for overseeing construction safety, and, more importantly, developing and overseeing the implementation of emergency preparedness plans for all hydropower projects. Based on the latter initiative, a national plan for emergency preparedness of all hydropower projects will be developed, and specific guidelines on emergency preparedness/disaster management for the hydropower sector should be developed.

In the short term, a team of four, including the Head, is recommended. One of the staff

should have a civil/environmental engineering background (to liaise with the engineering functions), one a *physical* sciences background (to coordinate with NEC and work on environmental parameter monitoring), one a *social* sciences background (to address resettlement and livelihood restoration, and to liaise with the GNHC, *Dzongkhag*, and *Gewog* administrations), and one a safety management background (to address construction worker safety, community safety and emergency preparedness in a structured manner across all hydropower projects).

For the 11th Five-Year Plan, the DHPS has obtained approval for one Engineer and one environmental engineer/officer to be positioned in the Socio-Environmental Section. As this is below the requirement suggested, it is important to request to augment this capacity at the very earliest. Based on the experience of using the capacity of this initial team, decisions on growing this team should be considered. Terms of Reference for the Socio-Environmental Section in the DHPS should be developed and used for reference/guide for planning its activities.

Renaming the Socio-Environmental Section: With the staff positions in place (in accordance with the 11th 5-year Plan), it would be appropriate to christen it as the E&S Section, which is a mere variation of its existing name. This would make the nomenclature in line with generally accepted practices in the hydropower sector internationally.

Handing over the project-level day-to-day facilitation to DGPC: Discussions revealed that DGPC had been established to coordinate all aspects of project planning, design, and preparation. Currently, it is the DHPS that facilitated the DPR preparation. All of the above project-level facilitation activities are likely to gradually be transferred to DGPC, which has already established its own Environmental Unit. For a start, one relatively small project—the 118 MW Tangsibji Hydro Energy Limited (THyE) project at Nikachhu—has been given to DGPC for facilitating the DPR preparation and E&S studies. As DGPC's capacity is built, there should be no duplication of E&S activities between DGPC and the DHPS.

Strengthening the departmental stakeholder consultations on the draft EIA report: Discussions with the DHPS and NEC revealed that the prevailing procedure for collecting inputs/views/perspectives from stakeholder departments on the draft EIA report need to be strengthened. The DHPS should task particular individuals from these line departments with reviewing draft EIA reports and providing constructive feedback/inputs in this context. Particular individuals should be given sufficient time for these reviews and the reviews should be completed prior to a consultant's presentation of the EIA report in question. By identifying particular individuals and giving them adequate time for review, the procedure for involving other stakeholder departments is bound to become more effective.

Integrating major E&S issues in the periodic progress reporting: The periodic progress reports received from various Hydropower Authorities refer largely to the technical and financial progress. This progress reporting needs to be extended to include the E&S issues as well. Doing so will assist in proactively identifying E&S risks that could be attended before these issues turn into major problems. The Hydropower Authorities are also required to send annual compliance reports to NEC; during construction, these reports even have to be submitted monthly. It is not clear whether these reports are ever forwarded for review to the DHPS. The Socio-Environmental Section should review these progress reports and ensure their submission to NEC, thereby allowing proactive oversight of possible E&S risks and opportunities.

Druk Green Power Company (DGPC)

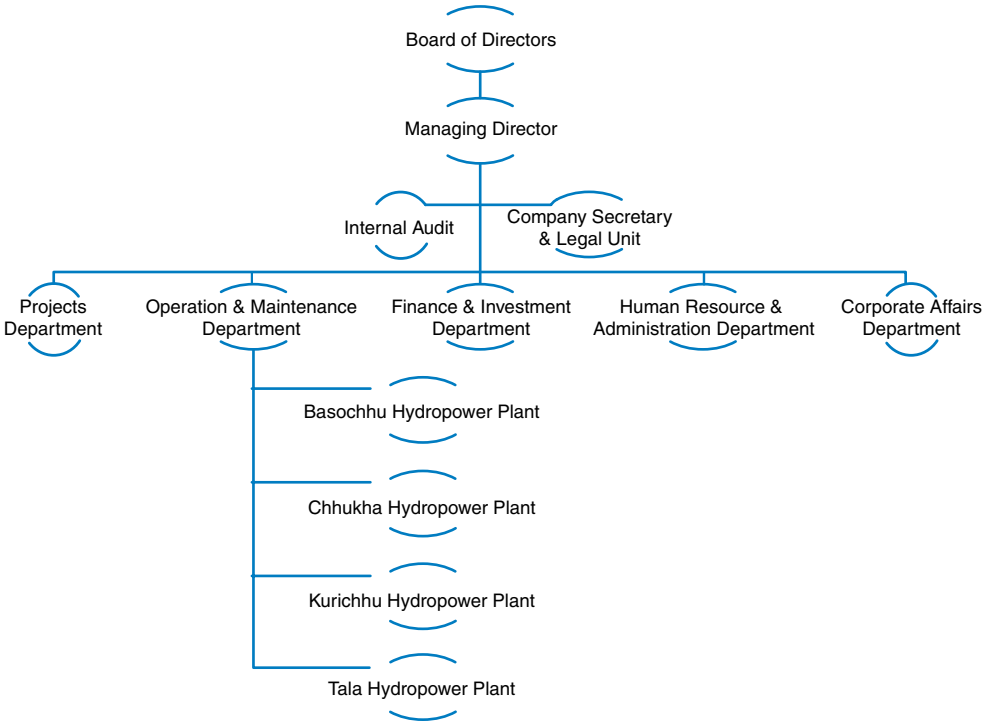
Existing situation

The responsibility for managing E&S issues rests with the Projects Department. There is an Environmental Unit under the Projects Department. This Environmental Unit reports to the Head, Druk Green Consultancy, which has been established to coordinate the preparation of prefeasibility, feasibility, technical, and DPR studies for projects in the pipeline. The capacity of Druk Green Consultancy is being developed further to provide consulting services in the hydropower sector in projects outside of Bhutan. The Environmental Unit coordinates the E&S studies pertaining to the DPRs prepared by DGPC/Druk Green Consultancy. However, it is envisaged that the Environmental Unit will eventually be able to conduct the EIA studies by itself, requiring only limited external expert support. At present, the Environmental Unit does have the capacity to review the EIA studies done by DPR Consultants. In fact, it is currently reviewing and updating the EIA for the Nyera Amari Hydropower.

As to staffing, the Environmental Unit has six officers. They are all science graduates and relatively young. Two of the six officers have been temporarily sent away to do a Master's program on water resources management with support from AusAid; two officers have been seconded in power projects in Mangdechhu and Nikachhu to gain field experience; and the remaining two officers are working on the EIA studies in support of the DPR preparation, and providing support to the hydropower plants that are under O&M—renewing their environmental clearances or dealing with other incidental issues. These four hydropower projects have no environmental units, and environmental management is the responsibility of this particular Environmental Unit.

All of these initiatives to develop in-house capacity to manage E&S issues for hydropower projects in Bhutan and offer capacity as a

Figure C-3 Organizational chart for DGPC



consulting service for overseas projects is a best-in-class approach and a good practice.

Based on discussions, it is understood that the role of DGPC in managing E&S issues includes the following:

- To provide technical support for and guidance on the preparation of DPRs for hydropower projects by consultants. As part of the DPR preparation, EA studies also have to be conducted. This preparation includes gathering all EIA documents (including the EMP, social assessments, and the RAP);
- To gradually build the required E&S capacity to conduct EA studies;
- To liaise with the NECS on matters related to obtaining environmental clearance from NEC;
- To hand over the roles and responsibilities of managing project-related E&S issues to the Hydropower Authority once it has been established. In the case of the 118 MW Tangsibji Hydro Energy Limited (THyE) project at Nikachhu, this handover was done by the book;
- To forward the various hydropower projects being facilitated by DGPC to the DHPS for approval from the RGoB for;
- To support NEC in ensuring the hydropower projects, which are currently under DGPC control for O&M, are compliant;
- To provide support on other environmental management issues during O&M such as e-flows, sediment issues, landslides, and monitoring catchment area treatment initiatives, as and when these need to be addressed;
- To develop awareness modules/video clips about good management practices in the O&M phase.

DGPC is also in the process of putting together systems to manage E&S issues. For a start, a Social Safeguards Manual has been produced to streamline the processes to manage social safeguard issues.

Possible areas for strengthening identified

Building capacity in DGPC's Environmental Unit: At present, all the staff members of the Environmental Unit have an educational background in physical sciences. While this is important for facilitating or conducting EIAs, the unit also needs staff with a background in civil engineering, safety management, and social sciences . For instance, social assessments will have to be done as part of the EIA preparation, and these are best done with the support of someone with a social sciences background. To be able to integrate the EMP requirements in the bid and contract documents, a civil engineering background would be desirable. Also, as worker and community safety during construction is an important, safety engineering expertise will also be useful to have within the core Environmental Unit of DGPC.

Discussions revealed that the current team of six staff members is sufficient for the current workload of the Environmental Unit. But additional staff to be hired should include individuals with a civil engineering, safety engineering, and also social sciences background. Ideally, the staff with a civil engineering background is seconded from another DGPC department, as this would promote coordination.

Strengthening procedures for integrating EMP requirements in contract documents: DGPC is involved in either developing the DPR and associated documents or facilitating the consultants' preparation of the same. Therefore, it is uniquely placed to ensure that one of the EIA outputs, that is, the EMP, is fully integrated with the bid/contract documents. As is well

known, the contractor will only implement the provisions of the contract. If the EMP requirements are not duly represented in the bid/contract document, chance are that these will not be implemented. In view of this, DGPC should strengthen its procedures to ensure that the EMP is duly incorporated into construction bids/contracts.

Renaming the Environmental Unit as the E&S Unit: Presently, although the unit manages environmental *and* social issues, it is called the Environmental Unit. To more accurately reflect the nature of its activities, it would be appropriate to rename it the E&S Unit (of DGPC).

Gross National Happiness Commission (GNHC)

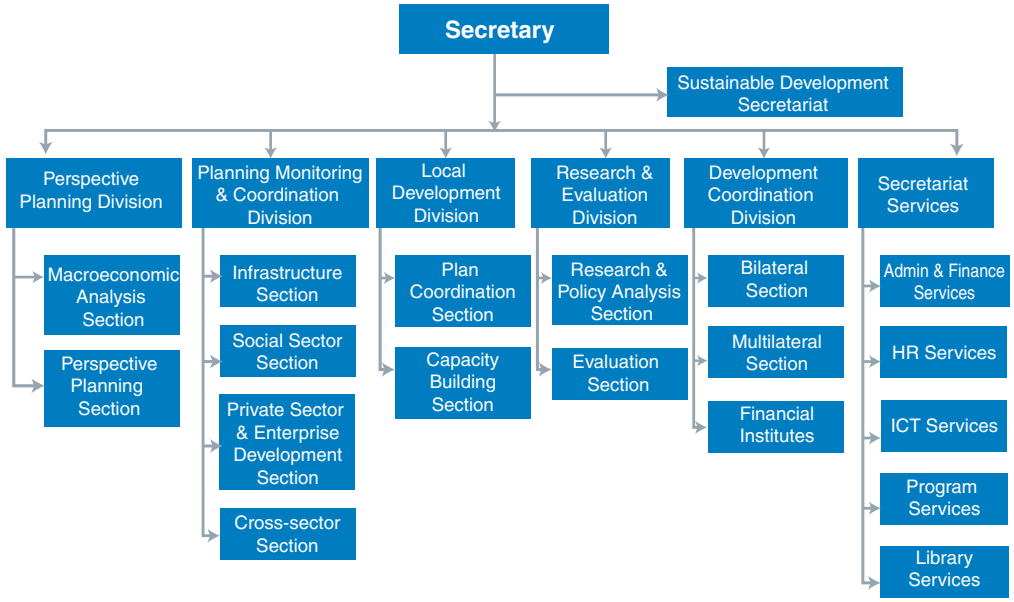
Existing situation

GNHC has a limited role in managing E&S issues pertaining to hydropower projects. From the EMP (including the RAP), certain funds earmarked for local development are given to the GNHC whenever convergence with the RGoB's development activities have to be ensured. When there is merit to involving the GNHC, the funds are routed through the GNHC. For instance, compensatory afforestation has to be arranged done through the Department of Forests and be included as part of its overall afforestation initiatives. In such initiatives, the Hydropower Authority indicates to the GNHC, the *Dzongkhags*, and *Gewogs* what these funds should be allocated to. The GNHC ensures there is no duplication of the budget for the same local development activities and releases these funds to the DA, which in turn arranges to use these funds in the identified *Gewogs* and the villages therein.

These funds are released in a manner similar to the budgetary allocation for development programs or schemes to be implemented in the *Dzongkhags* and *Gewogs*.

Decisions on social infrastructure projects such as expanding schools and hospitals are made by the Hydropower Authorities, in direct consultation with the pertinent DA. Being well-staffed and autonomous, the former

Figure C-4 Organizational chart for GNHC



are uniquely placed to execute such projects effectively and efficiently, without required the involvement of other RGoB agencies.

Possible areas for strengthening identified

Strengthening GNHC capacity, if required: Presently there are only a few hydropower projects and the fund allocations channeled through the EMP (including the RAP) are not substantial. Discussions revealed that the existing capacity of the GNHC would suffice for now. However, if the number of hydropower projects were to increase, then the GNHC's capacity to manage these funds for local development should commensurately increase. In particular, the GNHC may have to consider creating a separate division for streamlining the use of local development funds allocated through the EMP (including the RAP).

Building the capacity of the Dzongkhag **and** Gewog: At the *Dzongkhag* level, building the capacity of the DEOs and other development officers should be built in a structured and systematic manner. This capacity building should include training on the local development activities to be funded; moreover, at the gewog level, the administrative officers have to be trained to implement the local development activities relevant to their *Gewog*.

Institutionalizing the holding of socioeconomic surveys before, during, and after the construction phase of a HEP at the *Dzongkhag, Gewog,* and village levels. Discussions revealed that no socioeconomic surveys had been done yet before, during, and after the establishment of a hydropower project. The GNHC needs to address this gap: procedures/protocols for conducting a socioeconomic baseline survey before, during, and after the project should be developed. Moreover, these surveys should be held periodically to determine to what extent the local community has benefited from a specific hydropower project and in what stage. Comparison of the socioeconomic data collected at different stages of the project should help ascertain the impacts on local development.

List of meetings held

Department of Hydropower & Power Systems, Ministry of Economic Affairs, Ms. Tashi Pem, Executive Engineer, Hydropower Development Division; Mr. Sangay Dorji

National Environment Commission, Mr. Tenzin Khorlo, Chief, Environmental Services Division; Ms. Tshering Choden, Environmental Services Division, NEC Secretariat; Ms. Choki Wangmo

Druk Green Power Corporation Ltd., Mr. Kuenga Namgay, Executive Director, Operations & Maintenance; Mr. Dorji P. Phuntshok, Director (Projects); Mr. Chador Tenzin, Head, Green Consultancy; Ms. Sonam Pelden, Assistant Manager; Tandin Tshering, Assistant Manager

Bhutan Electricity Authority (BEA), Mr. Nima Tshering C., Chief, Licensing & Technical Division

Bhutan Power Corporation Ltd. Mr. Gem Tshering, Managing Director; Mr. Sonam Palden, Head, Environmental Division

WWF Bhutan Program, Ms. Sonam Choden, Program Manager, Living Himalayas Network Initiative; Mr. Phurba Lendup, Species and Water Program

Gross National Happiness Commission, Mr. Passang Dorji

Royal Civil Service Commission, Mr. Lhundup Wangchu, Commissioner

Royal Society for Protection of Nature, Mr. Kinga Wangdi, Program Officer

References

Legislations & regulations

RGOB NEC Hydropower Guidelines (2012)

RGOB National Environmental Protection Act (2007)

RGoB Environmental Act (2000)

RGoB NEC Regulation for the Environmental Clearance of Projects (2002)

RGoB Electricity Act of Bhutan (2001)

Other documents

DHPS Organizational Development Manpower of Department

Revised Social Safeguard Manual

DGPC Safety Manual (2011)

Websites

RGoB National Environment Commission, www.nec.gov.bt

RGoB Gross National Happiness Commission, www.gnhc.gov.bt

Drug Green Power Corporation (DGPC) Limited, www.drukgreen.bt

RGoB Ministry of Economic Affairs, Department of Hydropower & Power systems, http://www.moea.gov.bt/departments/department.php?id=6

Appendix D
Summarized Results of Hydropower Sustainability Protocol Assessment for Mangdechhu HEP

The Hydropower Sustainability Assessment Protocol

The Hydropower Sustainability Assessment Protocol is "a framework for assessing the sustainability of hydropower projects with a consistent, globally applicable methodology. Its objective is to improve environmental, social, and technical aspects of hydropower development and gain more public acceptance of hydropower."

"The Protocol is a series of assessment manuals corresponding to four different stages in the hydropower project cycle: Early Stage; Preparation; Implementation (including construction); and Operation. It contains definitions of good practice and best practice for over 20 sustainability topics that combine environmental, social, technical, and economic/financial perspectives. Not all topics, however, are relevant to every stage of the project cycle."

"The Protocol is not a certification scheme for sustainable hydropower, nor is it a replacement for assessments of E&S impacts. Rather, the Protocol assessment is a snapshot of project performance with the on-site assessment itself taking place over a matter of weeks." It is carried out by a team of Accredited Assessors, who visit the project site, review relevant documents, conduct interviews with stakeholders, and prepare a final assessment report.

"For each topic, two sets of scoring criteria are used: basic good practice (score of 3) and proven best practice (score of 5). A project must attain basic good practice on a particular topic before it can be scored against proven best practice for that topic. In order to achieve a score of 3 on a topic, a project must satisfy all of the scoring statements with no significant gaps. . . . The significance of a gap is determined based on the severity of the risk that it poses to the project and whether or not plans are in place and there is sufficient time to address the gap before it can have a major impact on the overall project."[48]

[48] Liden, Rikard; Lyon, Kimberly. 2014. *The Hydropower Sustainability Assessment Protocol for Use by World Bank Clients: Lessons Learned and Recommendations.* Water Partnership Program (WPP) Water papers. Washington, DC: World Bank Group.

Assessment of Mangdechhu Hydroelectric Project

This summary presents an Official Assessment conducted in accordance with the Implementation Tool of the Hydropower Sustainability Assessment Protocol (the "Protocol"). The assessment was conducted for the 720 MW Mangdechhu Hydroelectric Power Project, under construction on the Mangdechhu River in central Bhutan. The Mangdechhu River is a tributary of the Manas River, which in turn is a tributary of the Brahmaputra River in India.

The project developer is the Mangdechhu Hydroelectric Power Authority (MHPA), established in 2010 as a special purpose vehicle for the development of the Mangdechhu Hydroelectric Project (MHEP), in accordance with an inter-governmental agreement between the Royal Government of Bhutan (RGoB) and the Government of India (GoI). The GoI is providing 30 percent of the project costs as a grant, and 70 percent as a loan repayable in 30 installments over a 15-year period following project commissioning. The initial estimate of project cost was Nu 28,963 million (~USD 432 million) at 2008 price levels, revised to Nu 40,206 million (~USD 600 million) at 2014 price levels.

Project construction commenced in early 2011 and commissioning is planned for January–March 2018. The project at the time of this assessment was 60–70 percent complete, and is being delivered through eleven major contract packages: four for civil and hydromechanical works; five for electromechanical works; and two relating to the transmission line and substation. The MHPA presently has 469 staff, and 3,554 persons are employed for the hydropower project by the major contractors.

The Protocol's Implementation tool contains 20 topics that canvas issues relevant to governance, finance, technical, social, and environmental considerations. While the emphasis is very strongly on E&S issues in most topics, a holistic view of the project is important to put these issues in context and to understand competing pressures and trade-offs. The assessment focuses on the sustainability performance of the MHEP specifically but, for several Protocol topics, the governance framework including policies and legislation that apply more broadly comes under scrutiny as they influence the findings for the MHEP. This means that significant gaps are in some cases assigned that arise from causes beyond the direct control of the project itself.

Two topics are considered Not Relevant for the MHEP: topic I-10 Resettlement, because no households were physically displaced; and topic I-11 Indigenous Peoples, because the only ethnic minority in the project area is well away from, and not affected by, the project. All other 18 topics were fully assessed onsite in the period January 11–18, 2016, and the findings are presented in this report. Findings in relation to the transmission line are included, but limited to those that could be based on a few interviews and a review of the transmission line Environmental Impact Assessment.

Triangulation of evidence—visual, verbal, and documentary—is an important requirement for the evidence collection and analysis processes. To this end, particular attention was paid to interviews with project-affected communities, local authorities, and regulatory agencies. Follow-up evidence was requested by, and provided to, the assessors in the weeks following the assessment. The draft final report was provided to MHPA in March 2016.

Based on the evidence at the time of the onsite assessment, the project generally demonstrates very competent standards in its sustainability management. The majority of topics scored (12 out of 18 topics) performed at or better than the basic good practice level (a score of 3 or better out of a possible score of 5 for an

individual topic). It needs to be emphasized that meeting the basic good practice provisions of the Protocol is a highly commendable performance, and that proven best practice is quite difficult to achieve on a topic.

Eight topics exceeded the basic good practice level, with either no or only one significant gap against the proven best practice scoring statements: I-2 *Governance*; I-4 *Integrated Project Management*; I-5 *Infrastructure Safety*; I-7 *Project Benefits*; I-14 *Public Health*; I-15 *Biodiversity and Invasive Species*; I-16 *Erosion and Sedimentation*; and I-19 *Reservoir Preparation and Filling*.

Four topics met the basic good practice level reflecting strong and responsible performance. These topics do not exceed the level of basic good practice because of two or more significant gaps against the proven best practice scoring statements: I-1 *Communications and Consultation*; I-6 *Financial Viability*; I-8 *Procurement*; and I-17 *Water Quality*.

Six topics did not meet the basic good practice level: I-3 *Environmental and Social Issues Management*; I-9 *Project-Affected Communities and Livelihoods*; I-12 *Labor and Working Conditions*; I-13 *Cultural Heritage*; I-18 *Waste, Noise, and Air Quality*; and I-20 *Downstream Flow Regimes*.

The spider diagram (Figure D-1) summarizes the MHEP assessment in numbers, followed by a table showing the significant issues that have been identified (Table D-1).

Table D-1 categorizes gaps according to the six types of criteria that form a common structure across the Protocol topics—Assessment, Management, Stakeholder Engagement, Stakeholder Support, Conformance/ Compliance, and Outcomes—although not every topic includes all of these criteria. The criteria are in the form of scoring statements uniquely tailored to each topic. The table shows that some gaps apply to more than one criterion in a topic, or to more than one topic.

A closer look at the table shows that for those topics not meeting basic good practice, the gaps primarily relate to the scoring statements regarding the Assessment or Outcomes criteria.

Figure D-1 Sustainability profile

Table D-1 Table of significant gaps

Criterion	Level 3: Significant gaps against basic good practice	Level 5: Significant gaps against proven best practice
Assessment	*I-3 E&S Management:* Weaknesses in the EIA and a lack of scoping of cumulative impacts. *I-12 Labor & Working Conditions:* No systematic and comprehensive tracking, compilation, and analysis of the causes and consequences of safety-related injuries, accidents, and near-misses for workers, and measures that should be taken to avoid recurrence. *I-13 Cultural Heritage:* Absence of cultural heritage assessment in the EIA as well as lack of documented assessment elsewhere. *I-18 Waste, Noise, and Air Quality:* Not all relevant waste, noise, and air quality issues were identified in the EIA and EMP or subsequently during implementation, nor are they being systematically monitored and addressed through mitigation measures. *I-20 Downstream Flows:* There is no full assessment of the impacts of the changed flow regime on the ecosystem and social values in all downstream river stretches.	*I-1 Communications & Consultation:* Limited planning of project communications approaches for the wider body of stakeholders with an interest but no direct involvement in the project. *I-2 Governance:* Opportunities exist to improve governance processes—clarifying applicability of new legislation, high-level reporting on agreed sustainability indicators (e.g., environment, safety, labor, compliance, local capacity development), and maintenance of a compliance register. *I-5 Infrastructure Safety:* Limitations in the analysis and monitoring of road safety risks. *I-6 Financial Viability*: Limitations and inconsistencies in financial scenario testing, analyses of financial risk, and sensitivity analyses. *I-7 Project Benefits:* Unclear assessment of project benefit opportunities and risks in the context of regional development plans and objectives, and evaluation of measures to support sustained outcomes. *I-15 Biodiversity:* Biodiversity monitoring is on an issue-by-issue basis with a narrow scope and some gaps. *I-17 Water Quality:* The water quality monitoring program could be more systematically designed to ensure risks to the receiving environment are identified and analyzed.
Management	*I-3 E&S Management:* No public disclosure of the EIA and EMP. *I-18 Waste, Noise, & Air Quality:* Management of dust has been reactive, with limited effectiveness due in part to a lack of identification of and adequate planning for this issue at the project outset (*I-18 Assessment). *I-20 Downstream Flows:* The minimum downstream flow commitment has not been publicly disclosed (*I-3 Management).	*I-6 Financial Viability:* Social and environmental plans and commitments as reflected in financial management plans do not have well-considered financial contingency measures. *I-8 Procurement:* Sustainability criteria (e.g., relating to environmental, social, labor, safety, and/or human rights) are not included in prequalification criteria for the major works packages. *I-15 Biodiversity:* Biodiversity management processes will not anticipate and respond to emerging risks because of insufficient knowledge (*I-15 Assessment). *I-17 Water Quality:* Water quality management processes do not anticipate and respond to emerging issues with discharges to the receiving environment (*I-17 Assessment).
Stakeholder Engagement		*I-1 Communications & Consultation: Limited* inclusivity of engagement processes with directly affected community stakeholders and limitations to feedback on how issues raised have been taken into consideration, based on documented meeting records. *I-2 Governance:* No clear process linking what is of high interest to diverse groups of stakeholders with what is publicly reported in sustainability areas (*I-1 Assessment).

Criterion	Level 3: Significant gaps against basic good practice	Level 5: Significant gaps against proven best practice
Stakeholder Support		
Conformance/ Compliance		*I-4 Integrated Project Management:* There have been a number of nonconformances with specifications in the DPR, and noncompliances with contract provisions. *I-6 Financial Viability:* Nonconformances in financial processes have been identified through the joint audit process. *I-8 Procurement:* Nonconformances in procurement processes have been identified through the joint audit process. *I-16 Erosion & Sedimentation:* Some problems with contractors dumping excavated materials inappropriately. *I-17 Water Quality:* Noncompliances regarding water quality impacts.
Outcomes	*I-9 Project-Affected Communities:* The provisions of the Land Act (2007) for acquisition of private land do not constitute fair compensation for economic displacement. *I-12 Labor & Working Conditions:* There are constraints on workers' rights to freedom of association and collective bargaining, which are inconsistent with internationally recognized labor rights. *I-20 Downstream Flows:* Absence of clear objectives guiding evaluation and determination of downstream flow regimes (*I-20 Assessment).	*I-2 Governance:* There are some unresolved governance issues at this point in time, relating to clarifying applicability of updated legislation and resolving nonconformances from the joint government audits (*I-2 Assessment). *I-5 Infrastructure Safety:* Public safety risks relating to roads are not fully avoided, minimized, and mitigated (*I-5 Assessment). *I-7 Project Benefits:* There are uncertainties about the long-term sustainability of outcomes for project benefits (*I-7 Assessment). *I-15 Biodiversity:* Negative biodiversity impacts cannot be demonstrated to be avoided, minimized, mitigated, and compensated based on the level of knowledge (*I-15 Assessment). *I-16 Erosion & Sedimentation:* There have been problems regarding disposal of excavated materials, leading to increased sediment runoff from some point sources (*I-16 Conformance/Compliance). *I-17 Water Quality:* Not all water quality impacts are mitigated (*I-17 Conformance/Compliance).

Note: DPR = Detailed Project Report; E&S = Environmental and Social; EIA = Environmental Impact Assessment; EMP = Environmental Management Plan.

*Gaps that have been counted under a different sustainability criterion.

A number of these basic good practice gaps reflect shortcomings in the EIA conducted for the MHEP, not only in its scope and content, but also in the processes relating to public disclosure. Two significant gaps against the Outcomes criterion at the level of basic good practice are due to wider government policies that are not aligned with current international standards—those relating to land acquisition compensation and international labor rights. In most cases, it would only be possible to address these basic good practice gaps through more systematic government responses, which because of timing considerations may influence future hydropower projects more than the MHEP.

Gaps identified at the level of proven best practice are spread relatively evenly across all of the criteria and reflect a number of opportunities that could be considered to lift MHEP's sustainability profile. These considerations may be applicable specifically at the project level or more broadly for future hydropower projects in Bhutan.