# TAAS-0045: Adaptation to Climate Change in the Hydro-electricity Sector in Nepal

# Institutional Mapping and Assessment


Submitted by:

Nepal Development Research Institute (NDRI)-Nepal

in collaboration with:

Practical Action Consulting (PAC), Nepal

Global Adaptation Partnership (UK) Limited (GCAP)



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The work is led by Nepal Development Research Institute (NDRI)-Nepal in collaboration with: Practical Action Consulting (PAC), Nepal and Global Adaptation Partnership (UK) Limited (GCAP).

For further details, contact the team leader: Dr Divas B Basnyat, NDRI

divas@ndri.org.np

Telephone: +977-1-5537362, 5554975

## Acronyms

| | |
|---|---|
| ADB: | Asian Development Bank |
| CC: | Climate Change |
| CDKN: | Climate and Development Knowledge Network |
| CEA: | Central Electricity Authority |
| CERC: | Central Electricity Regulatory Commission |
| CIAT: | International Centre for Tropical Agriculture |
| CMIP5: | Coupled Model Intercomparison Project Phase 5 |
| COP: | Community of Practice |
| CPF: | Country Partnership Framework |
| CRA: | Climate Risk Assessment |
| DFID: | UK Department for International Development |
| DoED: | Department of Electricity Development |
| DRR: | Disaster Risk Reduction |
| EIA: | Environment Impact Assessment |
| EIB: | European Investment Bank |
| EPC: | Engineering Procurement Construction |
| ESSD: | Environmental and Social Studies Department |
| ETFC: | Electricity Tariff Fixation Commission |
| FNCCI: | Federation of Nepalese Chambers of Commerce and Industry |
| GCAP: | Global Climate Adaptation Partnership |
| GCM: | Global Circulation Model |
| GLOF: | Glacial Lake Outburst Flood |
| GoN: | Government of Nepal |
| GWh: | Gigawatt hours |
| GWP: | Global Water Partnership |
| IBN: | Investment Board Nepal |
| ICIMOD: | International Centre for Integrated Mountain Development |
| IEE: | Initial Environment Examination |
| IFC: | International Finance Corporation |
| IPPAN: | Independent Power Producers' Association |
| JICA: | Japan International Corporation Agency |
| MCC: | Millennium Challenge Corporation |

| | |
|---|---|
| MIGA: | Multilateral Investment Guarantee Agency |
| MoE: | Ministry of Energy |
| MoPE: | Ministry of Population and Environment |
| MoSTE: | Ministry of Science, Technology and Environment |
| MW: | Mega Watt |
| NAPA: | National Adaptation Programme of Action |
| NDRI: | Nepal Development Research Institute |
| NEA: | Nepal Electricity Authority |
| NPC: | National Planning Commission |
| NPPR: | Nepal Portfolio Performance Review |
| ODA: | Official Development Assistance |
| PAC: | Practical Action Consulting |
| PDA: | Power Development Agreement |
| PPA: | Power Purchase Agreement |
| PROR: | Peaking Run-of-River |
| PTC India: | Power Trading Corporation of India |
| ROR: | Run-of-River |
| USAID: | United States Agency for International Development |
| WB: | World Bank |
| WEC: | Water and Energy Commission |
| WECS: | Water and Energy Commission Secretariat |
| WGB: | World Bank Group |
| WRA: | Water Resources Act 1992 |

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The report is prepared by Dipendra Bhattarai of PAC, Nepal with initial inputs from Federica Cimato of GCAP. Divas B Basnyat (Team Leader), NDRI, and other members of the study team provided inputs to the report.

# 1 Background

There is a range of stakeholders involved in hydropower development, from policy decision makers, to developers and consumers. For a stakeholder consultation and engagement plan to be effective, careful consideration needs to be given to three factors: target (who to engage with), contents (what to communicate) and modalities (how to engage).

With this in mind, in the inception phase, the team carried out the institutional analysis and reviewed the regulatory framework regulating the sector with a view to understanding the roles and responsibilities of different actors in hydropower development, their exposure to climate change impacts, the various mechanisms through which they do or could support adaptation, and their influence. During the first phase of consultation, the team also started gathering information regarding different stakeholders' needs with respect to climate change adaptation, and their support to the study.

This section describes the team's approach to consulting and engaging with stakeholders, and based on the findings of the stakeholder consultations, it presents a proposed strategy for the stakeholder engagement.

# 2 Stakeholder Consultation and Engagement Plan

The project has the best chance of succeeding if it allows for feedback and input from major stakeholders, representing Government, academia, private sector and civil society. To ensure that the study is participatory and to create common ownership of its outcome, national stakeholders were consulted to help in identifying priority issues (relevant for different stakeholders), to ensure that the study is grounded within the national physical and political context, and to help identify feasible potential options for addressing climate change impacts. The participation of government staff, private developers, thematic experts and academia on a representative basis in the analysis, and their engagement in the work, has helped on-site capacity building.

**Table 2-1: Stakeholder consultation and engagement plan**

| Objectives | Methods | Outputs |
|---|---|---|
| Hold consultation meetings with Government and other relevant stakeholders/actors.<br>Agree overall project governance, key indicators of success<br>Identify entry points for adaptation options | Project Advisory Committee meetings<br>Consultation Workshops<br><br>One to one consultation with stakeholders | Formation of the Project Advisory Committee<br>Stakeholder workshops held<br><br>Entry points for adaptation options identified |

The stakeholder engagement focuses on working directly with key Government, private and wider stakeholders to address the key challenges and issues.

# 3 Analysis of stakeholders in hydropower development

In the hydropower sector, stakeholders face different incentives and constraints to adapt to climate change, and their ability to adapt and/or influence adaptation will vary depending on:

i) where in the project cycle a decision has to be taken, i.e. planning, design, construction, operation; and

ii) their adaptive capacity (e.g. access to finance, information etc.).

These main stakeholders in the hydropower sector can be grouped as follows against the phases in the project cycle in **Figure 3-1**:

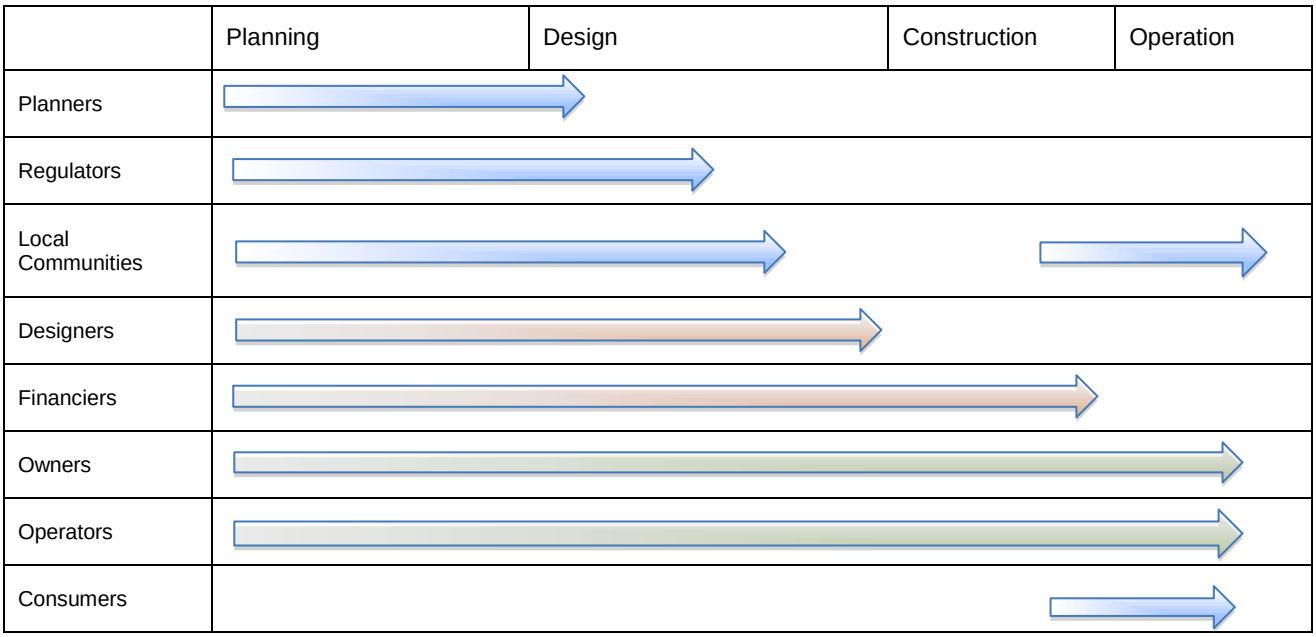


**Figure 3-1: Stakeholders in hydropower sector in project cycle**

**Planners and regulators** are able to influence adaptation of hydropower mainly at the planning stage. They can prompt adaptation through *policy instruments* that have impact beyond the project level, i.e. at a *system* level. Regulators also determine thresholds for environmental impacts (e.g. environmental flows) that can affect the design of dams and how they are operated.

**Project designers** influence adaptation at the design stage. They decide on the plant's capacity and technological designs, which in turn affect how well the facility is adapted to climate change. They can decide on applying safety factors (e.g. design for larger than normal loads or conditions), or build in flexibility features that allow for potential future modifications as climate change unfolds.

**Financiers** are also vested parties insofar as they face the same risks as the project owner of (1) the project not being completed on time, on budget, or at all; (2) the project not operating at its full capacity; (3) the project failing to generate sufficient revenue to service the debt; or (4) the project prematurely coming to an end. Debt usually starts to be served after construction is completed (or from commercial operation date (COD)) and continues during several years of operation (typically 12). Financiers have the ability to affect the economics of the project (i.e. the project needs to be economically feasible and generate enough revenues for debt service). Like regulators, financiers can impose environmental and social safeguards requiring design changes that ultimately may reduce the vulnerability of the project's performance to climate change.

**Developers, owners and operators** have the greatest ability to affect adaptation during construction and operation. The owners (including shareholders) ultimately decide on what level and type of risk the project is willing to stand; and during the negotiations of the concession agreement (project development agreement, PDA, in Nepal) and power purchase agreement (PPA) negotiate with Governments on who bears the risk and responsibility for managing those risks. Operators will be responsible for taking adaptation decisions during the life of the project. The Government being the ultimate owner of hydropower projects in Nepal is the only actor having a long-term interest (>30 years) in the good functioning and safety of individual plants and the system as a whole.

**Local communities** should have the ability to affect the design of a dam to ensure that social impacts are avoided or mitigated. During operation they could also play a role in ensuring the risks of climate change are monitored, and mitigated. Their ability to adapt is however limited during

construction (in fact during this time their adaptive capacity is expected to be lower and vulnerability to be higher during the construction period due to relocation, changes in livelihood etc).

Finally, **electricity consumers** are also relevant stakeholders insofar as they are directly affected by climate change risks through impact on services (e.g. unreliable supply) and could pay the costs of (hard) adaptation (e.g. trough higher tariffs if these are determined on a cost-plus basis).

## 3.1 Government Institutions

**Ministry of Energy**

The Ministry of Energy (MoE) and its Department of Electricity Development (DoED) have jurisdiction over the energy sector in Nepal. The ministry has been entrusted with the task of developing policies and plans for the conservation, regulation and utilization of energy. It designs system plans and sectorial policies, and reviews and approves project proposals and feasibility studies before they can be issued a license. The Ministry also leads on bilateral and multilateral dialogues, agreements and understandings regarding energy and electricity.

**Department of Electricity Development**

The Department of Electricity Development (DoED) functions as the chief coordination unit for promotion and development of the hydropower sector. It performs regulatory duties and is primarily responsible for awarding licenses to hydropower projects. It is also responsible for developing policies and programs for the development of the hydropower sector.

The main functions of the DOED are to process the license applications for survey and development submitted by the proponent, and oversee the conditions of the licenses. It also conducts feasibility studies of hydropower projects, and examines and reviews license applications, environmental impact assessments (IEE/EIA) and associated reports, and sends to Ministry of Energy and Department of Forest with its comments and suggestions. Besides, DoED also acts as a secretariat of the Electricity Tariff Fixation Commission (ETFC), and prepares guidance on environmental impact assessment and safety standards. However, these are poorly enforced particularly on small projects, which are not subject to same level of scrutiny and due diligence as large projects.

**National Planning Commission**

The National Planning Commission (NPC) is the advisory body responsible for the formulation of national development policies, plans and programmes under the directives of the National Development Council. It is responsible for preparing multi-year (3- and 5-year) development plans, as well as supervising ministries' plans and programmes to ensure they meet national and sectorial objectives. NPC approves and monitors the execution of the budget (capital investment) by various ministries.

On hydropower development, in coordination with MoE and NEA, NPC prepares plans which set generation targets to be achieved through both private and public investment over a 3- and 5-year timeframes. Besides, it facilitates the implementation of development policies, plans and programmes requiring cross-departmental and ministerial coordination.

**Investment Board Nepal**

The Investment Board Nepal (IBN) was created under the Investment Board Nepal Act, 2011.The Prime Minister heads the IBN, whose office is headed by the CEO who is also member secretary

of the IBN. The IBN is entrusted to promote economic development of the country by creating an investment-friendly environment.

IBN is a one-window service for potential investors in Nepal. It acts as a central agency for investment promotion and facilitation through mobilizing and managing PPPs, cooperatives, domestic and foreign investments, and supporting the development of infrastructure assets. In addition, the office of the IBN can select priority areas for investment.

Large hydropower (above 500 MW) investment is under the remit of the IBN: IBN evaluates project proposals with respect to their financial and technical feasibility, short list them, and lead the negotiations for project development agreements with private developers on behalf of the Government of Nepal. The IBN can access government as well as external expertise in order to fulfil its mandate.

**Water and Energy Commission**

The Water and Energy Commission (WEC) was established as an advisory body of the government for the formulation of policies, plans and programmes in the water resources and energy sector. The Commission and its secretariat, the Water and Energy Commission Secretariat (WECS), are responsible for formulating and assisting in developing policies and strategies in the water resources and energy sector, and for providing suggestions, recommendations and guidelines in developing irrigation, hydropower, and drinking water projects.

Besides, WECS is also mandated to formulate and develop policies and plans related to industrial use of water, flood management and in-land navigation along with the protection of the environment relating to the above sector. Specifically in hydropower, WECS contributes with DoED and NEA to formulate system plans, and select hydro projects applying for a licence.

**Ministry of Population and Environment**

The role and responsibilities of the Ministry of Population and Environment (MoPE) include the formulation and implementation of policies, plans and programmes that contribute to minimize the impact of climate change, environment sustainability, preservation of natural resources, promotion of sustainable practices and technologies, and management of climate change induced risks. MoPE formulates, coordinates, implements, monitors, and evaluates National Environment Protection Plan of Action, National Adaptation Plan of Action, National Adaptation Plan, Local Adaptation Plan of Action, Local Adaptation Plan of Action Framework and its Manual.

As far as hydropower development is concerned, the Environmental Evaluation division of MoPE is responsible to review and provide final go ahead for all environmental impacts assessments (EIA) and associated reports prepared by developers during their scoping studies. The MoPE also has a (separate) Climate Change Division responsible for drafting new policies, and implementing the climate change related policies.

## Department of Hydrology and Meteorology (DHM)

The Department of Hydrology and Meteorology (DHM) is an agency under the Ministry of Population and Environment (MoPE), Government of Nepal. DHM has a mandate from Government of Nepal to monitor all the hydrological and meteorological activities in Nepal. The scope of work includes the monitoring of river hydrology, climate, agro meteorology, sediment, air quality, water quality, limnology, snow hydrology, glaciology, and wind and solar energy. General and aviation weather forecasts are the regular services provided by DHM.

As a member of the World Meteorological Organisation (WMO), DHM contributes to the global exchange of meteorological data on a regular basis. The department is also a focal point for the Intergovernmental Panel on Climate Change (IPCC) and for the meteorological activities of the

South Asian Association for Regional Co-operation (SAARC). The International Civil Aviation Organization (ICAO) has recognized DHM as an authority to provide meteorological services for international flights.

DHM collects and disseminates hydrological and meteorological information for water resources, agriculture, energy, and other development activities. It issues hydrological and meteorological forecasts for public, mountaineering expedition, civil aviation, and for the mitigation of natural disasters. In addition, it conducts special studies required for the policy makers and for the development of hydrological and meteorological sciences in the region. It also promotes relationship with national and international organizations in the field of hydrology and meteorology.

**Nepal Electricity Authority**

The Nepal Electricity Authority (NEA) is a government-undertaking organisation that has as primary objective to generate, transmit and distribute adequate, reliable and affordable power by planning, constructing, operating and maintaining all generation, transmission and distribution facilities in Nepal's power system both interconnected and isolated. The NEA also carry out market analysis which is used to inform the Government (MoE and NPC) on short-term and long-term policy and planning.

The NEA is the only energy off-taker in Nepal (monopsony). The different and conflicting functions of the NEA are considered to be the root-cause of Nepal's inefficient energy market; and many stakeholders warrant restructuring and unbundling NEA with urgency.

In the fiscal year 2015-2016, domestic supply included 2168.56 GWh provided by NEA-owned power stations with a share of 2168.49 GWh from hydro and 0.07 GWh from thermal, out of which 1173.14 GWh was generated by independent power producers (IPPs). Power purchase from the IPPs and India (1758.41 GWh in 2016) is a major cost item in NEA's operating expenses and, in 2015-2016, they saw 8.33 % decrease over the previous fiscal year's figure. In fiscal year 2015/16, NEA suffered a net loss of NRs 7834.66 million (NEA, 2016)

NEA has Environmental and Social Studies Department (ESSD) within the Engineering Directorate. The Department is responsible for conducting IEE and EIA including environmental monitoring of NEA projects.

**Electricity Tariff Fixation Commission**

The Electricity Tariff Fixation Commission (ETFC) is an independent body, created in 1994, responsible for tariff fixation. It studies, evaluates and decides electricity tariff. It is a seven-member body headed by the chairman. . ETFC is meant to be an inclusive body that has representation from the bureaucracy, the electric utility sector, industry, consumers, and economists. The Member Secretary is the Director General of DOED and other five members represent from MOE, NEA, FNCCI, independent economist, and consumer society.

In 2014, it was agreed that tariffs applied to the customers availing NEA's power through dedicated feeder would be based on the cost plus principle (NEA Annual Report, 2014). However, the ETFC has been repeatedly been unwilling to adjust consumer tariffs unless the NEA's improves its inefficient operational performance.

## 3.2 International Financiers and Development Partners

**The World Bank Group**

In 2014, the portfolio of the World Bank Group (WGB) in the country was made of 20 active projects worth USD 1,506 million (**NPPR, 2014**). The WBG organize activities within two pillars.

Under the first pillar, it will support increasing economic growth and competitiveness, and will focus on hydroelectric power generation, enhancing transport connectivity, and improving the business environment. Under the second pillar, the WBG will provide support to increasing inclusive growth and opportunities for shared prosperity, by enhancing the productivity of agriculture, equalizing access to health care, skills development and social protection. In 2014, the WBG had USD 249.26 million committed to support hydropower and transmission line development in the country (**WB, 2014**).

In Nepal, IFC provides investment and technical advice to the private sector and Government, particularly on hydropower investment. In 2014, IFC partnered with Indian Infrastructure Company GMR Group to develop the 900-megawatt Upper Karnali hydropower plant (an export oriented project) and two transmission line projects. The Multilateral Investment Guarantee Agency (MIGA), which can provide political risk guarantees to investors and lenders, currently has no exposure in Nepal.

The WBG is an important player in the hydropower sector in Nepal. Its influence is also exerted through the Bank's social and environmental safeguards, which apply to the project the WBG finances. High due diligence standards are therefore guaranteed by the Bank's scrutiny on large projects.

In addition, the Bank has the obligation incorporate climate and disaster risk consideration into the analysis of the country's development challenges and priorities and, when agreed with the country, incorporates such considerations in the content of the programs and the results framework[1]. Specifically on hydropower, the Bank has been developing guidance on incorporating climate change risks screening into project planning and design.

**Asian Development Bank**

In 2014, ADB had 37 active projects and programs in Nepal amounting to USD 1,554 million (**NPPR, 2014**). Of this, 19% was on energy infrastructure, and 32% on urban and water supply. The ADB supports institutional reforms in the energy sector, for example by advising on the restructuring of the Nepal Electricity Authority and tariff regime revision.

**Japan International Cooperation Agency**

JICA has nine on-going program/projects in 2012/3 worth ¥19.07 billion (USD 166 millions) (**NPPR, 2014**). The economic infrastructure development area has received 92% of the allocation, followed by democratization support (5%) and rural poverty reduction area (3%). As part of its objectives, JICA aims to improve planning and facility establishment toward stable power supply as well as the planning capabilities of Ministry of Energy, and the technical standards of Nepal Electricity Authority.

JICA has been providing support to the Government of Nepal through the Power Generation and Transmission Capacity Improvement Program, which includes technical assistance on Power Generation and Transmission Capacity Improvement, Master Plan Study on Storage-type Hydroelectric Power Development, and financial support together with EIB and ADB of ¥15.137 billion (USD 127millio) of ODA loan agreement for the Tanahu Hydropower Project (140 MW).

**UK Department for International Development (DFID)**

[1] This requirement applies to all IDA Country Partnership Frameworks (CPFs), as per IDA 17 replenishment, Special Theme 3 on climate change.

UK's official development assistance during the period 2011-15 stands at £331 million. DFID's disbursement in 2012 – 2013 comprises climate change (17%), education (9%), governance and security (31%), water and sanitation (4%), and wealth creation (29%). The largest support to the hydroelectricity sector between 2011-14 was worth £12,8 milions of technical assistance to the IBN. Also, DFID funds the Nepal Climate Change Support Programme (£11,85 millions), which aim at increasing people's resilience to climate change, as well as access to energy (**NPRR, 2014**).

**USAID/MCC**

In 2014, USAID/Nepal had 11 active projects worth USD 71 million (**NPRR, 2014**). The portfolio covers on democracy and governance, climate changes, agriculture and food security, inclusive growth, and health sector.

The Millennium Challenge Corporation (MCC) has been developing a Threshold Program for Nepal, which plans to specifically focus on improving the enabling policy environment for both transportation infrastructure and hydropower generation (**USAID, 2014**).

**EU/ European Investment Bank**

In 2013, The EIB signed its first loan (EUR 55m) to the Government of Nepal to finance the construction and operation of the Tanahu hydro plant (140 MW).

**Denmark**

Denmark's portfolio in 2012-13 was approximately $40 million, of which 41% in renewable energy. But recent development is that they have pulled off hand.

**Norway**

Nepal receives annually NOK 200 million from Norway, of which NOK50 for clean energy and climate change.

## 3.3 Domestic Developers

According to the NEA (2014), by the end of fiscal year 2013/14, 148 PPAs have been signed. Upon projects' completion, these would generate nearly 2,000 MW of installed capacity. In 2014, the total number of IPP-owned projects that were in operation was 39 with a combined installed capacity of 255.65 MW.

**Independent Power Producers' Association, Nepal (IPPAN)**

Independent Power Producers' Association, Nepal is a non-profit, non-government autonomous organization that was established in 2001 to encourage private sector investment in hydropower in Nepal. One of its main purposes is to act as a link between the private sector and government organizations involved in developing hydropower in the country. Besides this, the organization also helps exchange technology, expertise, knowledge, financial and management information among the independent power producers in the country.

**Nepal Hydropower Association (NHA)**

Nepal Hydropower Association (NHA) is an association of individuals those working in hydropower sector such as students, engineers, lawyers, economists, professors, and environmentalist. NHA's major objectives are to lobby and advocate on helping create better enabling environment for hydropower development; provide capacity building support to hydro professionals, and investors. NHA can be one of the entry points to advocate on adaptation measures in hydro sector in Nepal.

## 3.4 Academic and Research Institute

**International Centre for Integrated Mountain Development (ICIMOD)**

ICIMOD is a regional intergovernmental learning and knowledge sharing centre serving the eight regional member countries of the Hindu Kush Himalayas – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – and based in Kathmandu, Nepal. Globalization and climate change have an increasing influence on the stability of fragile mountain ecosystems and the livelihoods of mountain people. ICIMOD aims to assist mountain people to understand these changes, adapt to them, and make the most of new opportunities, while addressing upstream-downstream issues

ICIMOD being a regional organization has been actively working in the water and energy sector. Recently, they have published a policy brief entitled "Benefit Sharing and Sustainable Hydropower in Nepal". They also have programme on monitoring the glaciers in Hindu Kush Himalayan Region both remotely and on field. ICIMOD also undertakes research on climate change including its impacts on cryosphere and serves as a knowledge hub for climate change impacts in the Himalay-Hindu Kush region including Nepal.

**Institute of Engineering (IOE)**

IOE is one of the oldest and largest engineering institutes under affiliation of Tribhuvan University. IOE offers PhD, graduate and undergraduate courses in different disciplines in different campuses and colleges. There are mainly six departments namely Civil Engineering, Mechanical Engineering, Electronics & Computer Engineering, Electrical Engineering, Architecture & Urban Planning, and Science & Humanities.

**International Water Management Institute (IWMI)**

IWMI is one of the leading organisation that has strong research base to provide evidence based solutions on sustainable water management, land resources for food security, livelihoods and the environment. Under CGIAR Research Programs WIMI hosts Water, Land and Ecosystem program.

# 4 Regulatory framework on hydropower in Nepal relevant to adaptation

**Regulatory framework relevant to electricity sector and climate change adaptation**

The main legislation governing hydropower in Nepal is the **Electricity Act 1992 and its regulation, the Electricity Regulation 1993. The Water Resource Act 1992 and the Water Resource Regulation 1993** also contain provisions regarding the use of water for hydropower generation[2]; and the **Environment Protection Act (1996) and Regulation (1997)** contains provisions on the environmental safeguards to be applied on hydropower projects. In 2011, the Government of Nepal adopted a Climate Change Policy, which contains some provisions concerning hydropower development as well. **Table 4-3** lists existing regulatory framework in hydro-electricity sector in Nepal.

[2] Neither the Electricity Act 1992 (2049 BS), nor the Electricity Regulation 1993 (2050 BS), explicitly provide for a right to use water for hydropower. However the Constitution of the Kingdom of Nepal, under Article 12, guarantees the freedom to practice any business or profession, which would therefore include hydropower (WaterAid, 2005).

## 4.1 Electricity sector

The Electricity Act 1992 and its Regulations regulate the electricity sector by a system of licensing. To obtain a license for the survey, generation, transmission or distribution of electricity, an application form must be submitted to the Secretary of Ministry of Energy (MOE) through Department of Electricity Development (DOED) along with a financial, technical and environmental study report. A survey license lasts for 5 years, meaning that during this time frame the developer has to complete the engineering studies and investigations, environmental studies, PPA and connection agreement and financial closure.

The Water Resource Act (WRA), 1992, Electricity Act, 1992 and Hydropower Development Policy, 2001 require that developers conduct an environmental study. Section 8 of WRA, 1992 requires preparation of an environmental study report by the proponent who wants to conduct survey or utilize water resources. Similarly Section 4 of the Electricity Act, 1992 requires preparation of an environmental study report by proponent desiring to conduct survey of production, transmission and distribution of electricity. The Hydropower Development Policy, 2001 encourages national and foreign private investors invest in electricity sector to develop hydropower projects in such a way that it would have minimum impacts on the environment.

For hydropower projects that produce electricity of more than 1000kW, transmit electricity through 33kV or more, and distribute electricity through >1MVA transformer, the developers must conduct environmental assessment before implementation. **Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA)** reports should be approved from the concerned body (ministry related to project, i.e., MoE) and the Ministry of Science, Technology and Environment (MoSTE), respectively. The main difference between the two is that IEE does not require scoping and public hearing, and its scope is generally limited to a list of anticipated impacts and mitigation measures to be implemented.

Despite the characteristics of a project, an EIA is required for projects located in any of the following areas: (i) historical, cultural and archaeological sites; (ii)environmentally weak and wet areas; (iii) National Parks, Wildlife Reserves and Conservation Areas; (iv) semi-arid, mountainous and Himalayan regions; (v) flood-prone and other dangerous areas; (vi) residential, school and hospital area; and (vii) areas with main sources of public water supply (**GoN, 2006**).

EIA has to identify, predict and evaluate potential environmental impacts, both beneficial and adverse impacts, and propose mitigation measures for significant adverse impacts, and enhancement measures for beneficial impacts. The EIA also has to contain recommendations on environmentally appropriate alternatives, and a framework for environmental monitoring, environmental auditing and environmental management plan. However, the EIA does not require developers take climate change into account in their environmental assessment.

In 2001, Nepal developed a **Hydropower Development Policy**. At the time of this report, the policy has not yet been followed by a supporting legal framework, though it is being used and referred to during negotiations of project development agreements (PDA). The Policy makes no reference to climate change adaptation, yet it lays out a strategy and policy objectives for hydro development whose implementation and achievement should require climate change considerations. For example, the Policy's strategy refers to the need to build small, medium, large and storage projects for hydropower development focusing on national interest, environment protection, and to maximize benefits in the development of water resources of Nepal. Also, it provides for minimizing the potential risks in hydropower projects with a joint effort of government and private sector, and in that respect it requires to make provisions for allocating risks to either the government or private sector based on their capability to bear them at the lowest cost. In order

to implement the strategy, a good understanding of climate risks is required.

Based on Interim Constitution of Nepal 2007, GoN has proposed a draft Electricity Act 2065 which has however not yet been ratified by the Parliament and is therefore not legally binding. Proposed electricity act 2065, in general, is more comprehensive in electricity development than the prevalent act, Electricity Act 2049 (1992). It is more focused towards rapid hydropower-development in Nepal. The act has opened more space in development of small plants (< 3MW) by removing license requirement condition and also relaxed the environment impact assessment need for projects less than 50MW. The act is aimed towards better management considering the nature of electricity plants and its capacity; and nature of work. This includes provisions for terms of license, transfer of license, power purchase agreement, royalty, security and other provisions. It also obligates the developers for insurance of power projects and as such, has introduced risk management practice into law. The proposed draft act has also defined the water rights to hydropower developers. One of major provision in the proposed act is providing right to a new regulatory body, the proposed Nepal Electricity Regulatory Commission (NERC) to fully regulate the power sector beyond just economic regulation currently carried out by the Electricity Tariff Fixation Commission (ETFC). With regards to protection of environment, the proposed act has explicitly guaranteed the amount of ecological flow in rivers. The act also emphasizes on local development and rural electrification. Besides, the provision for compensation to affected people, reestablishment and resettlement, and priority to local people are more elaborate and clear than the current Electricity Act 2049 (1992). **Table 4-1** provides a comparative overview of Electricity Act 2049 (1992) and Proposed Electricity Act 2065.

**Table 4-1: Overview of Electricity Act 2049 and Proposed Electricity Act 2065**

| **Aspect** | **Electricity Act 2049** | **Proposed Electricty Act 2065** |
|---|---|---|
| Capacity of HPP not requiring license for survey, generation, transmission or distribution | 100-1000KW | 100KW - 3MW |
| Time-duration for issuance of license | Fixed time for all HPPs | Varied time based on installed capacity |
| Multiple License to single person or corporate body | Not mentioned | No |
| Terms of license for HP | Maximum 5 year for survey<br>Maximum of 50 years for generation, transmission or distribution | For survey<br>1 year for IC < 100MW<br>2 years for IC>100MW<br>For generation 35 years<br>For transmission , distribution or trade - Maximum of 25 years |
| Renewal of license | One year before license expiry data | By 3 months expiry date for survey<br>2 years before expiry date for generation, transmission or distribution |
| Transfer of license | Not mentioned | Provision for transfer |
| Electricity development and operation under competition | Not mentioned | Provision |
| Buyer | Buyer - Nepal Government | Buyer - Corporate body with license transmission, distribution or trade |
| Power purchase agreement | Not clear | Necessary |
| Royalty | Fixed based on domestic | Categorization based on |

| | | |
|---|---|---|
| | and export | Installed capacity |
| Tariff fixation authority | Formation of Electricity Tariff Fixation Commission | Nepal Electricity Regulatory Commission |
| Insurance of HP infrastructure | Not mentioned | Mandatory till transfer of infrastructure to GoN |
| Water rights | No license shall be issued to any other person or corporate body for the distribution of electricity in the same area for the distribution of electricity in the same area for the whole term of such license<br><br>No definition of water rights | Definition of water right given for production of hydro-electricity |
| **Environment** | | |
| River ecology | Not clearly mentioned about ecology<br>Only mentioned that during generation, transmission and distribution environment should not be adversely impacted. | Define the amount of ecological flow:<br>Maximum of (a) ecological flow mentioned in EIA report or (b) 10% of minimum monthly average flow |
| EIA / IEE | Environmental report is needed | Only IEE is required for HPP <=50 MW |
| Social responsibility | Only basic compensation to affected is discussed. | More elaborate in terms of land acquisition of land and property; and their compensation.<br>Provision for reestablishment and resettlement<br>Priority of local area and local people |
| Investment | Not clear | Defined who can and how |
| Micro-hydro and rural electrification | | HPPs must allocate certain amount of hydro-electricity for rural electrification.<br>Provision of certain portion of royalty to local body and rural electrification |

Amidst the ongoing energy crisis, GoN has also developed the concept paper on ' National Energy Crisis Mitigation and Electricity Development Decade (Magh 2072 (Feb 2016))'. The objectives are (a) To identify and implement actions to end current energy crisis within one year (b) To provide energy security within 10 years through sustainable electrical energy development (c) To promote development of 'clean energy' focusing on hydropower as reliable source. Major action plan includes:

1. Declaration of Hydropower development decade from 2072/73 to 2082/83
2. To end the current load-shedding

**Production targets**

- To produce 1450 MW of electricity in coming three years from projects under construction- 200 MW in first year, 850 MW in second and 400 MW in third year.

- To implement policy to connect solar and wind energy to national grid such that its upper limit is 10% of added IC (100 MW in first year and 200 MW in second year)

**Transmission targets**

- To construct international transmission line from Dhalkebar to Mujjaffar

**Distribution targets**

- To develop distribution master plan and leakage control master plan in one year
- To implement peak-off peak tariff and implement Time of the Day (TOD) meter system to reduce peak-load and to distribute load in off-peak hours to domestic power supply

**Policy Decision**

- To evaluate 'National Energy Security policy' within 6 months
- To implement 'Take or Pay' system instead of 'Take and Pay' system in PPA in case of RoR projects with COD within 2082/83
- To facilitate bank or financial institutions to implement 15% of total investment in hydropower sector
- Accepting the Baisakh 2071/72 earthquake as Force Majeure, - to extend RCOD for affected under-construction hydropower and and PPA by maximum of one year for affected operating projects

**Administrative and process management**

- To waive penalty to HPP less than 10 MW if energy production decreases than contracted energy in PPA

**Rules and Regulation**

- To pass Energy Crisis Bill in legislation parliament
- To continue facility of VAT rebate of NRs 5 million per MW upto 2082/83 to HPP developed for internal consumption
- To continue income tax rebate (based on Electricity Act 2049) till upto 2082/83

3. For holistic and sustainable development of electric energy including hydro-power and alternative energy

**Policy**

- To fix Generation mix for long-term end of load sheeding as Storage and Pumped Storage projects 40-50%, PRoR 15-20%, RoR 25-30% and alternative energy 5-10%.
- To fix electricity tariff based on season and time as demand side management to promote investment and to improve financial status of NEA
- To fix purchase price based on season and time to promote environment for construction of PRoR and storage HPP
- To promote investment (shares) in big and attractive HPP - 51% of total investment shares from government and financial institutions and 49% from remittance / cooperative / people

**Planned Rural Electrification**

- To conduct pilot project in Kathmandu for 'Smart Meter' and 'Smart Grid'

**Process**

- To forecast load based on actual demand and not on 'supressed demand'

**Institution**

- To develop district level Energy Crisis Reduction coordination committee
- To restructure WECS to update production/transmission/distribution master plan, load forecast, analysis Techno-economic clearance. To update river basin master plan within coming 2 years
- To development government company for planned and under-construction storage project. To have rapid progress on work on West Seti HPP
- To establish one National electricity production company by studying medium and large scale HPPs to meet medium and long term demand
- To restructure NEA based on Federal structure and establish Electrical Boundary
- To establish National Electricity Trade company to export and import electricity

**Constitutional Arrangement**

- To evaluate and propose bill on new electricity act and National Electricity Regulation Commission to replace Electricity Act 2049
- To form Electricity Energy Crisis Mitigation Committee headed by Prime Minister

## 4.2 Climate Change Adaptation and National Adaptation Plan (NAP)

The Government of Nepal established the Climate Change Management Division in the then Ministry of Science, Technology and Environment (MoSTE) in 2010. The then MoSTE prepared the **National Adaptation Programme of Action (NAPA)**, which was endorsed by the Government in September 2010, and developed Local Adaptation Plans of Action (LAPAs) to implement adaptation programmes. With respect to the NAPA, since the global climate models and a composite national vulnerability index both failed to provide a practical information base, the MoSTE met the NAPA guidelines set by the United Nations Framework Convention on Climate using participatory methods to gather information from locations spread along three north-to-south transects across the country (**Dixit, 2012**).

Having recognized that climate change can result in adverse impacts for water resources and infrastructure, the Nepalese Government designed a **Climate Change Policy** (2011) to implement climate adaptation-related programmes, and take measures to mitigate adverse impacts. The Policy also aims to support the adoption of a low-carbon development path by pursuing climate-resilient socio-economic development; and develop capacity for identifying and quantifying present and future impacts of climate change, adapting to climate risks and adverse impacts of climate change.

Amongst the multiple activities foreseen in the Policy, there is that of monitoring the status of glaciers and glacier lakes through studies, and implement adaptation activities in priority vulnerable glaciers; forecasting water-induced disasters and risks resulting from climate change, and providing early warning information; developing necessary mechanism for the implementation of preventive measures; ensuring regular supervision, and enhancing capacity. Also, the Policy recognized the need to formulate and implement design standards for climate resilient infrastructure such as bridges, dams, river flood control and other infrastructure.

Based on National Adaptation Programme of Action (NAPA) that aimed to address impacts of climate change and National Framework on Location Adaptation Plan for Action (LAPA) to localize and ensure integration of climate change adaptation into local to national planning process, the National Adaptation Plan (NAP) formulation process in Nepal was initiated to prepare necessary instruments for identifying medium- and long-term adaptation needs, and responding to the

decisions of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) on the NAP process.

In Least Developed Countries (LDCs), NAP process will build upon the experiences in preparing and implementing NAPAs, as a means of (a) identifying medium- and long-term adaptation needs; and (b) developing and implementing strategies and programmes to address adaptation needs.

The NAP aims to reduce vulnerability to the impacts of climate change by building adaptive capacity and resilience. The objective is to facilitate integration of climate change adaptation, in a coherent manner, into relevant new and existing policies, programmes and activities, in particular development planning processes and strategies, within all relevant sectors and at different levels, as appropriate..

Understanding the urgency for enhancing initiatives to address medium- and long-term adaptation needs, the Government of Nepal, the current Ministry of Population and Environment (MoPE) – focal point for UNFCCC – launched the NAP formulation process in September 2015. This paved the way to explore supports, promote wider participation and engagement of partners and involve professionals in NAP process technical team. Nepal's NAP has received initial support from Action on Climate Today (ACT), a UK-Aid funded initiative.

Nepal's NAP process builds on NAPA experiences, and maintains a country-driven, participatory, multi-disciplinary and gender-sensitive approach. The MoPE is leading the national process to identify and prioritise medium- to long-term adaptation actions.

In the NAP formulation process to cover the climate change affected sectors, the MoPE is working through seven thematic working groups- (i) agriculture and food security (including nutrition); (ii) forest and bio-diversity; (iii) water resource and energy; (iv) public health (including water and sanitation); (v) climate-induced disasters; (vi) urban settlement and infrastructures; and (vii) tourism, natural and cultural heritage. Similarly, the two cross-cutting working groups are also included in the process, which are gender and marginalized group (social inclusion); and livelihoods and governance. The MoPE established the Technical Committee under the chair of the UNFCCC focal point for necessary coordination at technical level. The MoPE works with the concerned ministries to identify critical areas of technical support and capacity needs to formulate a comprehensive NAP document.

## 4.3 Other necessary legal arrangements for development of water resources

**The Project Development Agreement (PDA)** is the concession agreement between the Government and developers for the use of water resources for hydropower generation in Nepal. The concession agreement timeframe is 30 years for export-oriented projects, and 35 years for domestic projects. The PDA lays out obligations and risk sharing between the government and the developers in constructing, operating and managing the hydropower plant for the duration of the concession agreement. In 2012, with the support of international donors, the PDA template for export-projects (above 500 MW) was revised and brought up to international standards, and endorsed by the Nepalese Government. A similar template is being currently used to inform the negotiations of domestic projects as well, though the Government has not yet officially endorsed it.

Unless waived in writing by government, the company should satisfy different conditions. The company should have obtained the generation license, transmission license and any other government approvals. It should submit the performance security to the GoN. The company should have submitted to the GoN evidence confirming that the project is capable of achieving financial close. The company should have demonstrated to the GoN’s satisfaction that the project’s revenue

objective has been achieved as: a. in relation to the export/domestic power purchase agreement by obtaining relevant approval from the relevant importing country's electricity regulatory commission; b. in relation to the sale of power on merchant basis where price and volume of power are determined in open, competitive and approved electricity trading markets; and c. where the sale of power is bilateral, long-term basis between the company and a third party, the price and volume terms of such bilateral power purchase agreement achieves for the project the highest feasible proportion of the export energy alternative cost.

The company should be solely responsible for the project in accordance with the project specifications, applicable plans, and design standards. The hydro property should be fit for the purpose and carried out to the specified level of skill, care and diligence such that the hydro property is designed to achieve a minimum economic operating life of: a. 100 years for all civil works in the head works, including storage dam spillway, diversion weir, barrage, dam; b. 50 years for all other civil works and transmission line; and c. 30 years for all electrical and mechanical plants and their components. The generation license and the transmission should be issued for a period of 30 years in accordance with Electricity Act 2049.

The PDA template does not make specific reference to climate risks, yet it contains provisions governing potential climate-induced risks, such as force majeure and the management of GLOFs, as well as provisions concerning the handover of the project. Within one year of effective date, the company should conduct a study of potential effects on the Hydro Property of a glacier lake outburst flood. Upon completion of such study, a full and detailed report should be submitted to the GoN. If the GoN in consultation with the technical review panel determines that the installation of an early warning system in respect of a GLOF is required, the company should establish such a system at its own system in consultation with GoN.

The PDA document describes the Force Majeure Event as any event or circumstances or combination of events or circumstances beyond the reasonable control of the affected party, but only to the extent that such circumstance, event or condition, despite the exercise of diligence and good electricity industry practice, cannot be prevented, reasonably anticipated, avoided or overcome by affected party; such circumstance, event or condition prevents the performance by the affected party of its obligations under the agreement; the affected party has taken all reasonable precautions, due care and measures to prevent, avoid or overcome the effect of such circumstance on its ability to perform its obligations under this agreement and to mitigate its consequences; such condition is not direct or indirect result of a breach or failure by the affected party to perform any of its obligations under the agreement and such event or circumstances is without fault or negligence of the affected party. Other Force majeure events include the events or circumstances of earthquake, devastating flood, GLOF, storm of an historically exceptional nature, cyclone, typhoon, hurricane, lighting etc provided that where such events affects the hydro property or any other facility or equipment; events or circumstances such that fire to the extent such fire is beyond the design specifications and/or design standards of the hydro property or facility or equipment, explosion, landslides; epidemic or plague; any strikes, lock-outs, industrial disputes, industrial difficulties, work bans, blockages, picketing or similar action; any act of war or conflict; any acts of rebellion, riot, civil commotion, strikes of a political nature, act of terrorism; any radioactive contamination or ionizing radiation, toxic or dangerous chemical contamination, excluding circumstances where the source or cause of contamination or radiation is brought or has been brought into or near the site of contamination or radiation by the company.

The PDA also contains provisions regulating the handover of projects back to the Government. On the date of expiry of the concession agreement, the developer has to transfer all of its rights, title and interest in the project in good running condition to the Government free of cost and without any

liabilities to the Government. The PDA template also states that two years prior to the date on which the project is to be transferred to the Government, the developer will arrange for training, at its own cost and expense, of a sufficient number of staff of the Government to enable the Government to operate, maintain and manage the project to the standards required. The company should arrange training to the date on which the project is to be transferred at its own cost and expense to sufficient staff of the government. The parties should mutually agree the number of employees to be trained and the content, duration and period of training in order to satisfy the obligations on the company. Prior to the effective date and in accordance with the application for the generation license, the company should provide to the government performance security at the rate of 0.5 percent of the total of the total project cost determined at the feasibility study level or any other updated and/or upgraded study conducted thereafter per MW of installed capacity of the project. The company should pay capacity royalty and energy royalty to GN pursuant to the laws of Nepal in force.

PDA describes the EIA and IEE. The company should prepare and conduct the EIA/IEE in accordance with the laws of Nepal, key guidelines and plans. It should include consideration of the access roads, power house, embankments, tunnels or canals, headworks, camps etc. company should produce the executive summary of the EIA/IEE in both English and Nepali languages. Company should submit the EIA/IEE to GoN for approval. The approved EIA/IEE should be an integral part of this agreement and the project, and the company should comply, and promptly rectify any non-compliance, with environmental, occupational, health and safety requirements detailed in the approved EIA/IEE and the plans.

For the resettlement and rehabilitation, the company should comply with i. the local procurement and development plan, ii. The employment and skills training plan, iii. The corporate social responsibility plan, iv. The rehabilitation and resettlement plan, v. environment management plan, vi. The environmental impact assessment report, vii. The initial environmental examination report, viii. The Nepal benefits plan. The company should resettle, rehabilitate and compensate project affected people in accordance with the plans. The company should implement the rehabilitation and resettlement plan to ensure that the living standards and livelihood of the project affected people shall be higher than the standard prevailing sixty days before the agreement date.

**Power Purchase Agreement (PPA) and Consumer Tariffs** are also relevant in shaping the incentives and barriers to adaptation. PPA rates are those NEA or the off-taker pays to energy producers. PPA rates are negotiated on a project-by-project basis and for Nepalese producers average NRs. 4.44 per KWh (**Asia Foundation, 2014**). Current PPA rates are of two types, one for winter months from mid-December to mid-April and other for the other eight months. The former rate is approximately twice as much as the latter rates. PPAs for export-oriented projects are negotiated between developers and the foreign off-takers (e.g. PTC India). In the case of projects exporting to India, tariff rates are set on a cost-plus basis and regulated by the Indian authorities (CERC and CEA).

NEA has been running financial losses for several years, with losses amounting to NRs 5.7 million in 2014 only. The organization points to low consumer tariffs (and hence the price-cost gap) as one of the main drivers for such poor performance. The NEA is also currently facing difficulties in meeting its financial obligations under US dollar-denominated PPAs, which are subject to exchange rate fluctuations.

Tariff rates are determined by the Electricity Tariff Fixation Commission (ETFC), which is responsible for reviewing and approving tariff requests made by the NEA and other licensed authorities under the Electricity Act of 1992. In FY 2011/12, ETFC approved to increase tariff by 20% while instructing NEA to comply with certain conditions regarding loss reduction, inventory

management, receivables management and administrative reform (**NEA Annual Report, 2014**).In 2013/14, the NEA requested the ETFC to approve a further increase in consumer tariffs. However, ETFC has been reluctant to approve such increase unless NEA undertakes further reforms and improves its operational performance. Starting mid-September 2016, electricity tariff has been planned to increase by 19 per cent, as decided by the **ETFC (The Himalayan Times, 2016)**.

Nepal Electricity Regulatory Commission (NERC) is expected to come into existence under in-process Nepal Electricity Regulatory Commission Act, 2008 which shall replace ETFC. As mentioned in the act, NERC shall have full regulatory framework than ETFC and the roles and responsibilities of NERC are more clear, focused and detailed compared to ETFC, along with wider area of intervention and has coined many sources of fund along with Nepal Government. **Table 4-2** presents overview of ETFC and NERC.

**Table 4-2: Overview of ETFC and NERC**

| | **ETFC** | **NERC** |
|---|---|---|
| Organizational Structure | The team consist 7 members<br>Person prescribed by Government of Nepal from non- governmental sector - Chairperson(3 year term)<br>Director General of the Electricity Development Centre shall be the Secretary of the Commission and the Electricity Development Centre shall work as the Secretariat of the Commission. | The team consist 5 members<br>Person prescribed by Government of Nepal from non- governmental sector - Chairperson (5 year term)<br>Secretary of the Ministry of Water Resource shall be the Secretary of the Commission |
| Functions & Duties | Electricity Tariff Fixation<br>To fix electricity tariff and other charges to be charged to the consumers against the services rendered to them<br>To review tariff rates and other charges to be charged to the consumers against the services rendered to them through the generation, transmission or distribution of the electricity by the licensee.<br>The Commission may change tariff not exceeding more than five percent in the prevailing Electricity Tariff and only once a year.<br>The fixed tariff rate and other charges as determined by the Commission shall be published in a notification for the general public. | Electricity Tariff Fixation<br>1.Under this heading it shall<br>• Fix tariff rates and other charges to be charged to the consumers<br>• Acknowledge the licensee for achieving PPA<br>• Transmission and Wheeling Charge Fixation<br>• Fix the cut-off price for Tariff and Other costs/charges for Plants of 1 -10 MW.<br>2.Investigate tariff allocated for 1 MW projects upon complaints from its consumers<br>3.Dissemination of tariffs in National Daily Newspaper<br>4.The tariff once fixed may not be subject to change for a year once decided |
| | | Management of Technical Aspect<br>• Ensure National Standard safety and quality of Electricity distribution<br>• Draft laws and acts to ensure effectively managed and organized electricity production, transmission, and distribution<br>• Monitor the electricity service development if it is in line with domestic demand (upto 25 MW) |
| | | Maintain competency in Electricity Market and ensure the preservation of consumer rights |

| | ETFC | NERC |
|---|---|---|
| | | • Ensure consumer rights<br>• Prevent monopoly in Electricity tariff |
| | | **Enhance institutional capacity building of licensee for good governance**<br>• Advise Nepal Government to develop policy related to electricity and development in the sector of electricity<br>• Monitoring and evaluation of implementation of rules and regulation of licensee performance and work during execution of<br>• Assist in Settlement of dispute among licensee and consumer regarding tariff and other charges<br>• Ensure that licensee pay the penalty if found violating the rules and regulations<br>• Conduct public hearing after fixation of tariff and other charges |
| Source of Fund | Government of Nepal | Government of Nepal<br>National and International Donors (with Government Approval)<br>Penalties<br>Income tax (1 % of Annual Income)<br>Wheeling Charges<br>Other sources |

Additionally, because Nepal's electricity rates already rank among the highest in South Asia **(Pyakuryal, 2009 in: Asia Foundation, 2014),** increasing rates would most likely be unpopular among consumers, particularly given the government's inability to realize the country's enormous hydropower potential and continuous load-shedding (up to 12 hours per day, in 2014).

Hydrologic risks are or should be accounted for during tariff negotiations between the developers and the off-taker. The Government and NEA are generally reluctant to share the hydrologic risks with the developers, and so far they have opposed developers' requests to revise tariffs to accommodate hydrologic changes. Whenever developers generate less than what is agreed in the PPA, they are obliged to pay financial penalties to the NEA.

**Table 4-3: Current regulatory framework on hydropower**

| | |
|---|---|
| **Electricity Act (1992)** | • Governs the use of water for hydropower production.<br>• Establishes a system of licensing.<br>• Sets out the powers, functions and duties of a license holder.<br>• Provides certain financial incentives for license holders.<br>• Sets out the powers of the government. |
| **Electricity Regulation (1993)** | • Sets out the procedure for obtaining a license.<br>• Deals with the acquisition of house and land and compensation.<br>• Sets out the powers, functions and duties of license holders. |
| **Water Resource Act** | • The umbrella Act governing water resource |

| | |
|---|---|
| **(1992)** | management.<br>• Declares the order of priority of water use.<br>• Vests ownership of water in the State.<br>• Provides for the formation of water user associations and establishes a system of licensing.<br>• Prohibits water pollution. |
| **Environment Protection Act (1996)** | • Requires certain persons/bodies to conduct an EIA or IEE.<br>• Deals with the prevention and control of pollution. |
| **Environment Protection Regulation (1997)** | • Lists the water related projects required to conduct an EIA or IEE.<br>• Deals with the control of water pollution and pollution control certificate. |
| **Hydropower Development Policy (2001)** | Strategy and policy objectives for hydropower development, including:<br>• To maximise benefits in the development of water resources<br>• To minimise the potential risks in hydropower projects<br>• To share the risk, allocating the non-mitigable risks to either the government or private sector based on their capability to bear the risk at the lowest cost |
| **National Adaptation Programme of Action (2010)** | • Glacial Lake Outburst Flood (GLOF) monitoring and disaster risk reduction |
| **Climate Change Policy (2011)** | Setting priorities for climate change reliance and risk disaster reduction, including:<br>• Monitoring the status of glaciers and glacier lakes<br>• Forecasting water-induced disasters and risks created from climate change and providing early warning information<br>• Formulating and implementing design standards for climate resilient construction of bridges, dams, river flood control and other infrastructure. |
| **Project Development Agreement (PDA)** | • 30-35 year contract agreement between the Government and the developers regulating the construction, operation and maintenance of hydropower projects<br>• Defines obligations and risk sharing for the parties in the agreement<br>• Defines who bear the costs of climate-induced events (e.g. GLOFs)<br>• Defines handover obligations |
| **Power Project Agreement (PPA) and Tariff** | • Agreement on sale rates between developers and off-takers<br>• Hydrologic risks built into the rates but largely shared by developers<br>• Tariff restructuring needs to be approved by ETFC<br>• Flat rate for wet/dry season, no differential tariff for peaking<br>• Currently not formed on a cost-plus basis<br>• Financial penalties paid by operators generating less than minimum agreed in PPAs |

# 5 Mapping of Stakeholders and Possible Entry Points

Table 5-1: Stakeholders and possible entry points

| Type of adaptation | Option | Who implements? | Entry Points |
|---|---|---|---|
| 1) Existing Plants | Existing climate variability (now), plus early climate trends over next decade or two. | | |
| **Hard measures** Aim for low regret but note high cost of retrofit | **Flood risk (extreme flow) (will vary with RoR, PRoR and storage, as well as catchment/location)**<br>• Raising the dam crest/ dam heighten;<br>• Construction of new auxiliary spillways, or through changes on the existing spillways to increase their discharge capacity.<br>• Install gates, fuse gates, or fuse plugs to keep the same full supply level or even to raise it (more likely to be low regret).<br>• Increased protection for vulnerable structure (e.g. intake structures) (more likely to be low regret).<br>• Check dams | Primarily operators, but may be implemented through guidance or PPAs (Government/ regulatory) or requirement of Banks<br><br>But difficult to implement retrospectively into guidance and PPA for existing plants | Design Phase; and the Independent Power Producers<br><br>Ministry of Energy to include these options on hydropower development design guideline<br><br>Department of Hydrology and Metrology to generate quality data on flood forecast |
| | **Sediment risk ( note options will vary with low and high sediment rivers)**<br>• Removing sediments to increase reservoir capacity (dredging, flushing)<br>• Retrofitting to improve sediment management (build sediment trapping structures, and sediment routing structures) or continuous flushing device<br>• Check dams, debris basins/traps or reservoirs upstream to trap eroded sediments<br>• Retrofit of turbines before end of turbine lifetime (40 years) if damaged by sediments or to respond to higher flows.<br>• Re-coating turbines. | | Design Phase; and the Independent Power Producers<br><br>Ministry of Energy to include these options on hydropower development design guideline<br><br>Department of Soil Conservation and Watershed Management to keep the database of basin based sediment flow<br><br>Technical consultants should be aware with this issue and should incorporate |

| Type of adaptation | Option | Who implements? | Entry Points |
|---|---|---|---|
| | | | it in the technical details. |
| | **Low season flow risks (will vary with RoR, PRoR and storage, as well as catchment/location)**<br>• Retrofit turbines (or upgrade replacement)<br>• Increasing storage: dam heightening or increasing the full supply level (e.g. through installation of fuse gates)<br>• Divert some flows from an adjacent watershed into the reservoir (diversion and water conveyance structures) | | Department of Hydrology and Meteorology<br><br>Independent Power Producers<br><br>Technical Consultants<br><br>Hydropower Development Guideline |
| | **GLOF risks (GLOF vulnerable plants only)**<br>• Retrofit increased protection for structure (e.g. intake structures)<br>• Options to address high flows (see extreme flows)<br>• Note also Governmental action (e.g. draining lakes, etc)<br><br>(note plants further downstream may not get GLOF, but may get sediment from GLOF)<br><br>**Other**<br>• Strengthen transmission lines to improve resilience to load fluctuations, and reduce risk of disruption (e.g. using barriers to protect from landslides)<br>• Interconnection of energy systems within the same country and across regions to build resilience | | Ministry of Energy<br><br>ICIMOD<br><br>Independent Power Producer<br><br>Environmental Impact Assessment<br><br>Nepal Electricity Authority (NEA) |

| Type of adaptation | Option | Who implements? | Entry Points |
|---|---|---|---|
| **Soft measures** Aim for low regret, but operational flexibility and supporting legislation needed. | All<br>• Watershed monitoring and data collection<br>• On line / real time monitoring (e.g. precipitation data).<br>• Improve understanding of current adaptive gaps and system performance under current climate (no regret)<br>• More information on hydrological flows above 3000 m<br>• Voluntary approaches to encourage uptake (e.g. through industry associations) | Some public good aspects for Government<br><br>Some operators<br><br>Bank conditions for loans | Department of Soil Conservation and Watershed Management<br><br>ICIMOD<br><br>Financial Institutions |
| | **Flood risk (extreme flow)**<br>• Enhanced flood warning systems to shut-down (low regret).<br>• Awareness campaigns, e.g. on risk of floods, to improve disaster risk-preparedness (no regret)<br>• Insurance and other financial instruments (building on current)<br>• Reducing reservoir levels before the heavy rain/flood season (although this might result in generation losses),<br>• Developing operating rules that optimise storage/generation and flood attenuation benefits<br><br>**Sediment risk**<br>• Collection of sediment data to improve management<br>• Insurance (not for routine sediment and major damage covered above, only insurance for probabilistic large)<br>• Soil and water conservation programs to reduce | IWRM and watershed management Government<br><br>(part of royalties go to local area) | Department of Hydrology and Meteorology<br><br>Department of Soil Conservation and Watershed Management<br><br>Department of Soil Conservation and Watershed Management<br><br>Insurance Company |

| Type of adaptation | Option | Who implements? | Entry Points |
|---|---|---|---|
| | sedimentation and increase yields<br>• Slope stability monitoring<br><br>**Low season flow risks**<br>• Improving weather forecast systems to optimise reservoir operations;<br>• Improving cooperation between different plants, particularly if they operate in a cascade fashion in the same basin;<br>• Insurance and other financial instruments (insurance against drought years? but note under PPA don't pay under declared DSM drought years)<br>• Reservoir management<br>• Run turbines at lower/higher capacity based on runoff; or for less/more hours if the reservoir can provide some storage<br><br>**GLOF risks**<br>• Enhanced monitoring and early warning systems (how many existing plants?)<br>• Insurance and other financial instruments<br>• Awareness raising<br>• Use of district royalties to regions and districts to improve monitoring, install warning systems | | Department of Hydrology and Metrology<br><br>Independent Power Producer<br><br>Ministry of Energy<br><br>ICIMOD |
| **Regulatory measures** | **All**<br>• Changing guidance or PPA incentives<br>• Switching to different tariffs/price agreements to incentivise | | Independent Power Producer<br><br>Ministry of Energy |

| Type of adaptation | Option | Who implements? | Entry Points |
|---|---|---|---|
| | • Changes in penalty regime (e.g. existing reduction during drought periods, but might need to expand) | | Nepal Electricity Authority |
| | **Flood risk (extreme flow)**<br>• Introducing retrospective changes to design standard for existing plants (difficult)<br>• Introducing periodic and mandatory dam safety reviews (low regret) to alert operators of the need to increase discharge capacity | | Department of Hydrology and Metrology |
| | **Sediment risk**<br>• Watershed management (e.g. up-stream afforestation) | | Department of Soil Conservation and Watershed Management |
| | **Low season flow risks**<br>• PPA/tariff incentives: currently fixed price dry and wet, government reviewing tariff, encourage storage if space allows.<br>• Integrated Water Resource Management and manage competition for water. ((for conjunctive management of competing water users)<br>• Establishing water management systems like reduced assurance of supply, which may be adjusted for different water users based on whether they would suffer severe economic prejudice.<br>• Increase the opportunities of electricity trading via interconnected power pools;<br>• Demand-side management (benefits from reduced peak and loss of load) | | |

| Type of adaptation | Option | Who implements? | Entry Points |
|---|---|---|---|
| | • Enhanced use of power pools and trading<br><br>**GLOF risks**<br>• Regulation for EWS?<br>• Retrospective design standard upgrade | | |
| | | | |
| **2) Planned schemes currently at scoping/ design** | Future changes (>2030). Potential for changes in generation (kWh) and revenues, but also risks of low flow and security of supply/risks of damage from high flows<br>Risks occur towards the end of economic lifetime of plant.<br>Discounted and uncertain future benefits (>2030) versus costs today.<br>High uncertainty on future changes. | | |
| **Hard measures** | **Flood risk (extreme flow) (note that change in return period vary with catchment, plant type)**<br>• Low-cost incremental over-design, e.g. extra design contingency for high flows, increase flood storage capability (see current plants).<br>• Increased protection for key structure (e.g. intake structures)<br>• Plan for dam raising and create buffer zones around the reservoir limiting land use to allow dam raising in the future (flexibility)<br>• Plan for supplementary spillway capacity (flexibility)<br>• Plan for additional spillways and by-pass tunnels (flexibility)<br>• Bury power house underground (all or partial)<br>• Check dams | | Independent Power Producers<br><br>Technical Consultant s<br><br>Department of Hydrology and Meteorology<br><br>Department of Soil Conservation and Watershed Management<br><br>Ministry of Energy<br><br>Guideline for Hydropower Design<br><br>Environmental Impact Assessment<br><br>Ministry of Population and |

| Type of adaptation | Option | Who implements? | Entry Points |
|---|---|---|---|
| | • Dam structure (concrete versus rock filled)<br><br>**Sediment risk (note difference low and high sediment rivers)**<br>• Construction of larger outlets, diversion tunnels, check dams or reservoirs upstream to trap eroded sediments, or upstream check dams (these options tend to be costly, but for some such as check dams can get recovery and sale of sediment)<br>• Introduce enhanced trapping devices, e.g. centrifugal separation of fine sediment not gravity Hydrocyclones<br>• Continuous flushing mechanism<br>• More advanced sediment routing structures<br>• Consider parallel outlet tunnels in the design phase (to deal with sediments) (robustness).<br>• Dam heightening (higher cost).<br>• Choice of plant, PRoR able to better manage high sediment loads (sediment advantage) (but note depends on topography)<br><br>**Low season flow risks**<br>• Consider number/size/type of turbines that perform well across a range of streamflow scenarios (high cost) (robustness)<br>• Choice of plant (stie level), PRoR versus RoR versus storage (noting at individual site, choice depends on topography in many cases, but sometimes may be a choice between Ror and PRor | | Environment |

| Type of adaptation | Option | Who implements? | Entry Points |
|---|---|---|---|
| | • Increasing storage: dam heightening or increasing the full supply level (e.g. through installation of fuse gates)<br>• Consider different alternative for design, i.e. pumped storage plants<br><br>Number of units and type: some units more efficient low flows as well as normal, or if smaller number units (4 units vs 1 unit) may get higher efficiency- but trade off optimal efficiency (issue of flow and transport of turbines to plant, i.e. getting larger turbine to remote sites)<br><br>**GLOF risks**<br>• Increased protection for key structure (e.g. intake structures)<br>• Set back or raising of structure<br>• Build powerhouse and/or other structure underground (more costly)<br>• Design for GLOFs (over design, dam heightening, spillways, etc). | | |
| **Soft measures** | All<br>• Improved hydro-met and Hydrological / Water information systems.<br>• Real time on-line information<br>• watershed monitoring and data collection<br>• Improve understanding of current adaptive gaps and system performance under current climate (no regret)<br>• Climate risk screening (site screening to reduce risks) | | Department of Hydrology and Metrology<br><br>Department of Soil Conservation and Watershed Management<br><br>Ministry of Energy (hydropower development guideline) |

| Type of adaptation | Option | Who implements? | Entry Points |
|---|---|---|---|
| | • Climate risk screening tools<br><br>**Flood risk (extreme flow)**<br>• Improve data collection and monitoring (low regret):<br>• Enhanced flood warning systems (low regret).<br>• Awareness campaigns, e.g. on risk of floods, to improve disaster risk-preparedness (no regret)<br>• Insurance and other financial instruments (building on current);<br>• Operational management (as for current plants)<br><br>**Sediment risk**<br>• Sediment monitoring to optimise the operation and design of future plants.<br>• Soil and water conservation programs to reduce sedimentation and increase yields<br>• Slope stability monitoring<br><br>**Low season flow risks**<br>• Improving weather forecast systems to optimise reservoir operations;<br>• Improving cooperation between different plants, particularly if they operate in a cascade fashion in the same basin;<br>• Insurance and other financial instruments (insurance against drought years? but note under PPA don't pay under declared DSM drought years)<br>• Reservoir management | | Ministry of Population and Environment |

| Type of adaptation | Option | Who implements? | Entry Points |
|---|---|---|---|
| | • Run turbines at lower/higher capacity based on runoff; or for less/more hours if the reservoir can provide some storage<br>• More peaking RoR projects.<br>• Integrated Water Resource Management planning<br><br>**GLOF risks**<br>• Avoid or reduce siting in high risk areas<br>• Enhanced monitoring and early warning systems, plus awareness raising programmes<br>• Early warning systems<br><br>• Adopting a river basin approach with respect to monitoring climate risks<br>• Smart licensing along the river basin to account for cascade effects<br>• Changes in maintenance regime to address drying out of reservoir basins and embankment structures<br>• PPA and concession agreement requirements | | |
| **Regulatory measures** | **All**<br>• Include climate requirements (climate risks) in feasibility studies that submitted to NEA<br>• Develop guidelines for developers on what climatic info should be used for EIA, minimum environmental flows etc.<br>• Develop guidelines on risk screening in guidelines for developers<br>• Include climate risk screening in NEA approval process. | | Department of Hydrology and Metrology<br><br>Department of Soil Conservation and Watershed Management<br><br>ICIMOD<br><br>Nepal Electricity Authority |

| Type of adaptation | Option | Who implements? | Entry Points |
|---|---|---|---|
| | • Payments for ecosystem services to improve watershed management upstream<br>• Investigate policy and strategy for diversifying energy mix: risk diversification, e.g. different balance of RoR and storage, micro versus large hydro; solar, wind and hydro.<br>• Environmental and social safeguards (i.e. requirement applying to EIA, minimum environmental flows) – though do not include climate risk screening in EIA – too late in the process and needs to be in design and feasibility studies<br>• Change contract to incentives adaptation (e.g. lower royalty or lower equity stake (to recognise climate resilient) or lower free electricity level<br>• Change tariff and pricing structure in PPA with greater differentiation on seasonal/daily, e.g. to incentivise PRoR plants rather than RoR.<br>• Penalty regime, and how might change under a changing climate (e.g. low season penalties relaxed given changing variability – though noting this could incentivise inaction)<br><br>**Flood risk (extreme flow)**<br>• Change design standards, e.g. 1 in 250 rather than 100 (trade off damage and down time versus costs)<br>• Periodic and mandatory safety review (low regret)<br><br>**Sediment risk**<br><br>**Low season flow risks**<br>• Changes to PPA or pricing (see earlier) | | Ministry of Environment and Population<br><br>Environmental Impact Assessment |

| Type of adaptation | Option | Who implements? | Entry Points |
|---|---|---|---|
| | • Choice of plant at system level, e.g. encourage more storage or peaking run of river projects (through various methods, e.g. through PPA incentives)<br>• Integrated Water Resource Management and manage competition for water.<br><br>**GLOF risks** | | |
| | | | |
| **3) Future potential plants that will be needed on system (2020 to 2050)** | Major non-marginal changes in flows or major systematic shifts in risk by 2050, e.g. transformation rainfall, ENSO shifts Unlikely to be addressed through BAU. Very high costs, but very high uncertainty, risk of major costs for impacts that do not happen. | Who document and who monitor and who disseminate | |
| **Hard measures** | **GLOF risks**<br>• Reducing volume of water in the lakes (system wide)<br>• Preventative measures around the lakes (e.g. reducing material likely to cause surge waves) | | ICIMOD and Department of Hydrology and Metrology |
| **Soft measures** | **All**<br>• Enhanced meteorological and precipitation trends<br>• Enhanced hydromet and WIS<br>• Investing in downscaled climate projections<br>• Data collection on insurance costs and payouts<br>• Investment in new research programme<br>• Continuous update and improvement of design standards (cycle) | | Department of Hydrology and Metrology<br><br>Department of Soil Conservation and Watershed Management<br><br>ICIMOD |

| Type of adaptation | Option | Who implements? | Entry Points |
|---|---|---|---|
| | **Plant level**<br>• Introduction of in situ monitoring<br>• Pilot studies with on-site monitoring for learning<br>• Research on new technologies<br><br>**System level**<br>• Introduction of climate change into system planning (and choice of plant/size/location)<br>• Investing in new models that able to cope with climate variability (WASP is not so good at modelling hydro)<br><br>**Sediment risk**<br>• Sediment monitoring will be important to optimise the operation and design of future plants.<br><br>**GLOF risks**<br>• Enhanced monitoring schemes to track changes in risks (e.g. monitoring, GLOF monitoring R&D)<br>• Early warning; | | |
| **Regulatory measures** | **All**<br>• Identification and agreement of Institutions to study and document | | |

# 6 References

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