STOCKTAKING FOR NATIONAL ADAPTATION PLAN (NAP) FORMULATION PROCESS IN BHUTAN

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Glossary of Bhutanese Terms

Chiwog	Village or a group of few hamlets
Dzongkhag	District
Drungkhag	Sub-District
Gewog	A county, the lowest government administrative unit, made up of a group of villages.
Gups	Head of the Gewog
Thromde	Municipality

List of Acronyms

ABI	Association of Bhutanese Industries
APIC	Agency for Promotion of Indigenous Crafts
APA	Annual Performance Agreement
AWLS	Automatic Water Level Station
AWS	Automatic Weather Station
BCCI	Bhutan Chamber of Commerce and Industry
BNCA	Bhutan Narcotics Control Authority
BNLI	Bhutan National Legal Institute
CCCC	Climate Change Coordination Committee
CI	Climate Information
COP	Conference of Parties
CSOs	Civil Society Organizations
DDM	Department of Disaster Management
DGM	Department of Geology and Mines
DHI	Druk Holding & Investments
DHS	Department of Human Settlements
DMEA	Department of Macroeconomic Affairs
DoFPS	Department of Forests and Park Services
DoHS	Department of Hydromet Services
DRA	Drug Regulatory Authority
DRE	Department of Renewable Energy
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EWS	Early Warning System
FEMD	Flood Engineering Management Division
FYP	Five-year plan
GCF	Green Climate Fund
GCM	General Circulation Models
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GLOF	Glacial Lake Outburst Flood
GNH	Gross National Happiness
IPCC	Intergovernmental Panel on Climate Change
KGUMSB	Khesar Gyalpo University of Medical Sciences of Bhutan
KPIs	Key Performance Indicators
LDC	Least Developed Country
LEG	Least Developed Countries Expert Group
LGs	Local Governments
LGKRA	Local Government Key Result Area
MASL	Elevation in meters above sea level
MFCTC	Macroeconomic Framework Coordination Technical Committee
MoAF	Ministry of Agriculture and Forests
MoEA	Ministry of Economic Affairs
MoF	Ministry of Finance
MoHCA	Ministry of Home and Cultural Affairs
MoIC	Ministry of Information and Communications
MoLHR	Ministry of Labor & Human Resources
MoWHS	Ministry of Works and Human Settlement
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Actions
NCHM	National Center for Hydrology and Meteorology
NCWC	National Commission for Women and Children
NDCs	Nationally Determined Contributions

NEC-S	National Environment Commission Secretariat
NEX-GDDP	NASA Earth Exchange Global Daily Downscaled Projections
NKRAs	National Key Result Areas
NSB	National Statistics Bureau
OAG	Office of the Attorney General
PLAMs	Planning and Monitoring System
PRECIS	Providing Regional Climates for Impacts Projects
RAMSAR	Ramsar Convention on Wetlands of International Importance
RCPs	Representative Concentration Pathways
RCoJ	Royal Court of Justice
RGoB	Royal Government of Bhutan
RMA	Royal Monetary Authority of Bhutan
RSPN	Royal Society for Protection of Nature
RUB	Royal University of Bhutan
SDGs	Sustainable Development Goals
SKRAs	Sectoral Key Result Areas
SOP	Standard Operating Procedure
SWOT	Strength Weaknesses Opportunities and Threats
TCB	Tourism Council of Bhutan
TWG	Technical Working Group
UN	United Nations
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
WMD	Watershed Management Division

Executive Summary

A successful National Adaptation Plan may mean that adverse climate induced disasters are avoided, or their impact is lessened, but the absence of events is difficult to measure. Further, the impacts to be avoided are not expected to occur until sometime in the future, progress in advance of the event will be difficult to monitor. Climatic events, such as heavy rainfall have led to floods, erosion and landslides in Bhutan, and the mountainous regions have become increasingly susceptible to glacial lake outburst floods (GLOFs). These events have led to loss of lives, infrastructure, decrease in agricultural crop yields, decrease in hydropower generation due to changes in water distribution and GLOFs. Increase in overall temperature have become a threat to biodiversity causing species migration, spread of invasive species and increasing propensity for forest fires in Bhutan.

Adaptation measures and strategies play an important role in reducing the overall vulnerability to climate change in Bhutan. United Nations Framework Convention on Climate Change (UNFCCC) established the national adaptation plan (NAP) to facilitate adaptation planning in least developed countries (LDCs) and other developing countries. Bhutan decided to prepare its National Adaptation Plan and availed the NAP readiness financing from GCF through the project “Preparation of a National Adaptation Plan (NAP} for Bhutan, with a focus on the water sector”.

Stocktaking relies on the premise that its useful for a country to compile information on such ongoing and past adaptation activities (projects, programmes, policies and capacity-building efforts) and to analyse how the support and funding was received, the timelines, and their overall effectiveness. This information can give an indication of the status of the country’s enabling environment for adaptation.

There are seven success factors identified by GIZ (2016), representing important steps in building an effective NAP process. These were derived from UNFCCC and LEG guidelines. This report covers six of the success factors for its analysis. Desk research, followed by stakeholder consultations was carried out to understand the present climate change situation, vulnerability, and trade-offs between climate change adaptation and development policies to mainstream climate change adaptation into development plans. Representatives from government, private sector, civil society and academia were also consulted to gather the valuable inputs to strengthen stocktaking reports.

With respect to overall availability of technology and resources for projecting climate change, weather forecasting, early warning systems, it was found that it is possible to move ahead with adaptation planning at the current level of downscaling and emission scenarios that are available. Historical climate trends indicated an increase in temperature both at mean seasonal and mean annual scales and a decreasing trend in rainfall at mean annual scales. However, it is required that dzongkhag level vulnerability assessments are conducted. Climate change vulnerabilities and impacts are available at sectoral level such as the water sector, agriculture, forest, infrastructure, disaster risks, glaciers and glacial lake outburst floods. Similarly, adaptation strategies in Bhutan have been identified through a technology needs assessment for Bhutan focussed on three priority sectors – water, agriculture and natural hazards.

In terms of the long-term vision and mandate for adaptation the institutional arrangements for climate governance and legislative and regulatory frameworks available for adaptation were assessed. It was found that Bhutan has an existing institutional framework to coordinate all matters relating to the environment including climate change. But it does not translate down to local government and is not a strong mandate in some key departments.

For implementation success factor, budgetary strategies for adaptation implementation at national and sector levels were reviewed. It was found that the NAPA I & II formed a set of priorities which included identifying immediate projects and activities that could help communities adapt and to integrate climate change risks into the national planning process. Enhancing sustainability and climate resilience of forest and agriculture landscape and community livelihoods in Bhutan (NAPA III), Pilot Program for Climate Resilience (PPCR), Strategic Program for Climate Resilience (SPCR) and the new GCF project ‘Supporting climate resilience and

transformational change in the agriculture sector in Bhutan' allows for adaptation implementation experience. However, there is a need for resource mobilization strategy as implementation of adaptation is ad hoc and development partner based.

The review of the fifth success factor on integration of adaptation issues into national development strategies, sectoral strategies and planning process at subnational level (Dzongkhag, Gewog level) showed that while gender, environment, climate change, disaster and poverty were integrated into the 12th FYP, climate adaptation needs to be integrated into local development plans. There is also a need for climate change awareness and information about climate risks, opportunities, and trade-offs across local governments and few departments.

Assessment of participation reflected the need for increased inclusion of officials from the local Dzongkhag/ Gewog level. Participation of private sector was absent with regards to climate change adaptation and it was found that there is a need to improve stakeholder engagement. Also, it is required to better understand impact of climate change on women and use indigenous and tradition knowledge in adaptation programs in Bhutan.

Under M&E it was noted that there is conceptual ambiguity about what constitutes successful adaptation among national departments, local governments. Further at present, there is no formalized repository or database for measurement of climate indicators in Bhutan. Indicators on climate adaptation are scattered throughout different departments and remain unconsolidated. The fragmented approach is compounded by the lack of a common platform for climate adaptation and mitigation in Bhutan, making it difficult for key stakeholders to share information.

Overall, climate change adaptation is present strongly in the long-term vision and mandate, however the weakest link is the M&E and Integration of climate into local plans. While the key sectors for NAP are infrastructure, energy, agriculture, health, forest, biodiversity and glaciers; studies have shown that tourism sector can be impacted by climate change through reduced tourist inflow, impact on biodiversity etc. causing reduced sector development. As it a very important sector, due consideration must be given to include climate impact on tourism in Bhutan across all stocktaking success factors.

Based on the gap and barrier analysis, and consultation with TWG, following are some of the key recommendations that are suggested:

- Compiling and sharing existing information on vulnerability and adaptation options;
- Development of a repository/ database of climate information;
- Completing Vulnerability and Risk Analysis at Dzongkhag and Gewog level;
- Developing a Resource Mobilization Strategy;
- Developing a NAP Framework;
- Expanding Stakeholder Engagement Mechanisms;
- Engaging Central and Local Governments in The NAP Process; and
- Developing an Institutional framework for Adaptation M&E

1. Introduction

Bhutan is a landlocked country in the Himalayan mountains covering an area of 38,394 sq. km. Geographically, the country can be divided into three major areas: southern foothills, inner Himalayas and higher Himalayas. The southern foothills rise from the plains to a height of 1,500m but are only about 20km wide. The northern region comprises of the main Himalayan range of high mountains. These are one of the most formidable mountainous terrains in the world, ranging from 100m to 7,550m in height. The inner Himalayas are the economic and cultural heartland of the country. These gradually rise to about 3,000m and contain the broad river valleys of central Bhutan. Such difficult geography of Bhutan translates into varying climatic conditions. Bhutan gets intense monsoon rain in the summer, with a relatively dry winter. This also makes it highly vulnerable to climate variability and natural hazards due to the very active geological conditions, great variations in slope, high-elevation terrain. An ICIMOD study suggest a 2 degree rise in global temperature can have the following impacts in Bhutan:[1]

- Landscape changes like GLOFs and landslides;
- Food insecurity;
- Increased disease, including malaria in the southern lowlands of Bhutan;
- Livelihood stresses and destruction;
- Water scarcity, in agriculture, community supply and hydropower generation;
- Population migration and cultural conflicts

People in Bhutan are primarily dependent on natural resources, facing multiple challenges associated with climatic hazards and under development. In this situation, adaptation measures and strategies are immediately needed to reduce the overall vulnerability to climate change in Bhutan. Adaptation to climate change is a necessary component of planning at all levels.

Bhutan launched its NAP process in 2015 with the definition of a national NAP road map and an update of the 2012 National Adaptation Programme of Action (NAPA). The NAP process is designed to enable countries to adopt comprehensive risk management approaches focusing how to design, coordinate and monitor national efforts in climate change adaptation, disaster management and risk reduction as part of national agendas. There are two main objectives of NAP as observed by the Least Developed Countries Expert Group (LEG) and United Nations Framework Convention on Climate Change (UNFCCC):

a) To reduce vulnerability to the impacts of climate change, by building adaptive capacity and resilience;
b) To facilitate the integration of climate change adaptation, in a coherent manner, into relevant new and existing policies, programmes and activities, development planning processes and strategies, within all relevant sectors and at different levels, as appropriate (decision 5/CP.17, paragraph 1).

1.1. Stocktaking for NAP

Bhutan already has experience on multiple climate adaptation projects. There are many activities already that have been designed and implemented as part of the NAPA process to address urgent and immediate adaptation needs. There are also activities that are being implemented by other stakeholders including civil society organizations. These projects/ activities have done studies on vulnerability and impacts of climate change and technology needs assessments. Stocktaking relies on the premise that its useful for a country to compile information on such ongoing and past adaptation activities (projects, programmes, policies and capacity-building efforts) and to analyse how the support and funding was received, the timelines, and their

[1] Bhutan Climate + Change Handbook (2016), Thimphu, Bhutan: Bhutan Media and Communications Institute. - 130. p

overall effectiveness. This information can give an indication of the status of the country's enabling environment for adaptation.[2]

The stocktaking would aim to be a synthesis of the state of the science on current climate variability and existing vulnerabilities, projected climatic changes, associated impacts and future vulnerabilities. This would develop a basis for further planning and guide efforts to improve this knowledge base. This synthesis would indicate what the major sources of climate risk are and would help inform decisions on where efforts should be directed for future data collection and analysis. In cases where such assessments are lacking or are inadequate, this would indicate a gap that would need to be addressed.

There are seven success factors identified by GIZ (2016)[3], representing important steps in building an effective NAP process. These were derived from UNFCCC and LEG guidelines. The definitions are as follows:

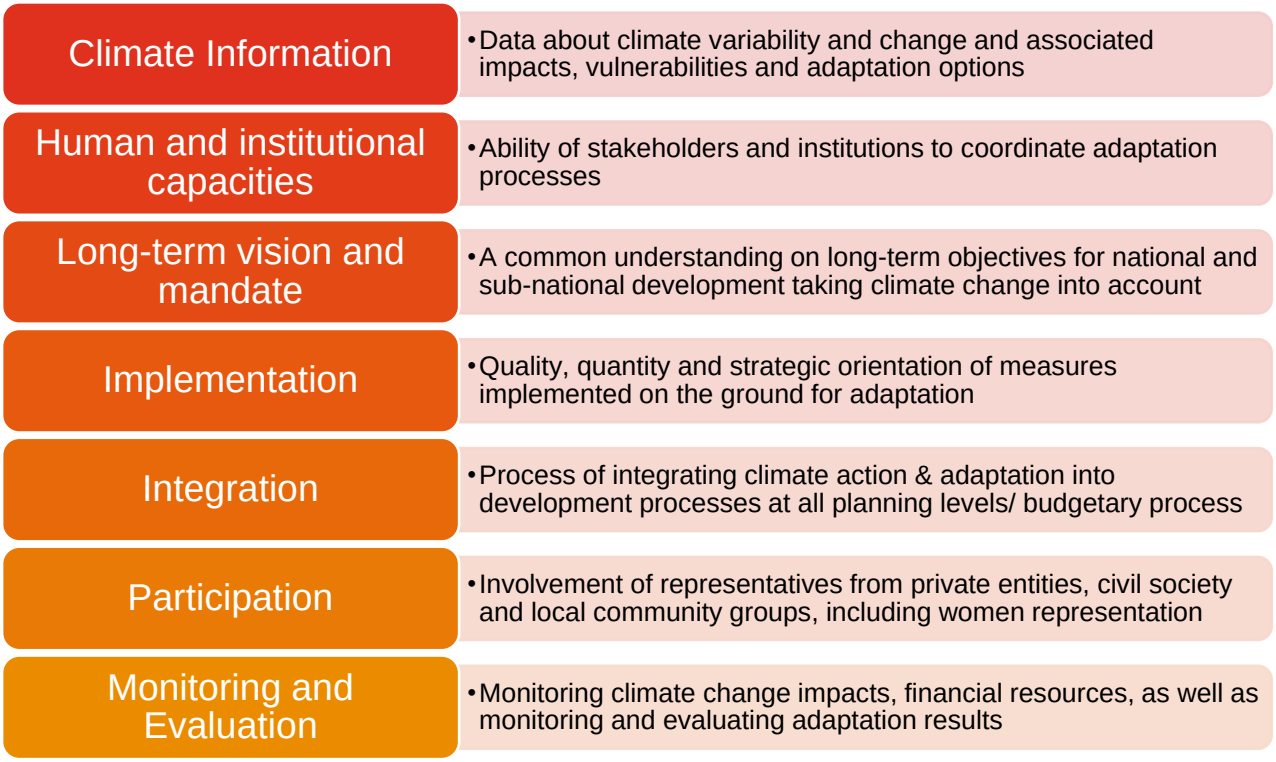

Figure 1: NAP success factors (GIZ SNAP, 2016)

This report follows six of the above given success factors for the analysis. Human and institutional capacities are covered under the report on "Skills Assessment for National Adaptation Plan (NAP) formulation process in Bhutan".

[2] Technical guidelines for the national adaptation plan process, 2012, UNFCCC
[3] GIZ, 2016, SNAP: Stocktaking for National Adaptation Planning; Assessing Capacity for Implementing NDCs

2. Methodology for Stocktaking

Desk research, followed by stakeholder consultations was carried out to understand the present climate change situation, vulnerability, and trade-offs between climate change adaptation and development policies to mainstream climate change adaptation into development plans. The representatives from government, private sector and civil society were also consulted to gather the valuable inputs to strengthen stocktaking reports.

Indicative list of sources that were considered for the desk research are:

- National Environment Strategy (NES)
- Bhutan Water Vision and Policy
- Strategic Program for Climate Resilience (SPCR) (2017), World Bank
- National Environment Protection Act (NEPA), 2007
- NAPA, I project, reducing climate change induced risks and vulnerabilities from GLOF covering 3 NAPA 2006 priority areas, implemented in 2008-2013 funded by the Least Developed Countries Fund (LDCF) and supported by UNDP.
- NAPA II project, Addressing the Risk of Climate Induced Disasters through Enhanced National and Local Capacity in Bhutan addressing 6 NAPA 2012 priority areas, funded by the LDCF and supported by UNDP, initiated in 2014.
- Second National Communication (SNC), 2011.
- Third National Communication (TNC) Draft, 2019
- 11th Five Year Plan, 2013- 2018 & 12th Five-Year Plan, 2018 – 2023.
- Bhutan's Nationally Determined Contribution (NDC), 2015.
- Vulnerability and adaptation assessment 2011 (during the Second National Communication to UNFCCC)
- Technology Needs Assessment for climate change adaptation 2013
- CC vulnerability and Adaptation planning report commissioned for NAPA III project 2016
- Gender Analysis Report under NAPA III Project 2016
- Feasibility Study for Bhutan GCF project 2017
- Asian Development Bank, "Water: Securing Bhutan's Future" (2016)
- Bhutan Water risk scenario and opportunities 2016 published by NECS and WWF
- RGOB National Statistical Bureau, Statistical Year Books of Bhutan
- A range of literatures and projects funded by bi-lateral and multi-lateral development partners on respective projects involving climate information systems, adaptation actions and enhancing disaster risk management approaches.

Stakeholder consultation

Full stakeholder list that were engaged is as follows:

Institution type	Name
National Climate Change Focal Institutions	NECS, GNHCS, NCHM
Central Ministries/Departments/ Technical Support	MoWHS (WFP, FEMD) MoEA (DRE, DGM, DOI-EU, DHPS) MoAF(DOA, DOFPS) MoHCA (DDM, DLG)
Local Government Institutions	Gewog level officials, Dzongkhag administration, Thromdes
Civil Society/ Private Sector	DHI, BCCI, ABI, CAB, CSOs (Tarayana Foundation)
Research and Support	RUB and REC

3. Climate Information

For effective climate action, government officials/ decision makers must be well informed and able to manage uncertainty due to climate change. They require information about climate impacts, vulnerability and technical options, in order to plan and implement concrete measures at national and local levels.

Climate information also allows for differentiating between a business-as-usual development goal from a climate resilient development goal, by adding long term risk and vulnerability considerations. There are many sustainable development practices that can improve climate resilience, offering indirect adaptation benefits, climate resilient development necessitates the use of information about climate vulnerability, risk and appropriate adaptation responses now and in the future.[4]

Climate information stocktake covers:

- **Climate science (observed and projected changes):** Data on variability and change in climate variables such as sea level rise, temperature, precipitation and extreme weather events.
- **Vulnerability/impact studies:** Data produced through vulnerability assessments, encompassing a variety of elements including sensitivity, exposure and adaptive capacity, requiring good baseline data.
- **Adaptation options**: Data on technical measures to adapt, including information on identifying and appraising adaptation options, in order to select the most appropriate actions
- Impacts of CC across the following sectors:
    - Water sector
    - Agriculture sector including livestock
    - Forest
    - Tourism
    - Energy (GIZ, SNAP, 2016)

3.1. Climate science (observed and projected changes)

There are very few localized studies undertaken to document observed and projected impacts of climate change in Bhutan. During the NAPA projects and Second National Communication (2011) some broad projected impacts were made. The National Center for Hydrology and Meteorology (NCHM), being the key responsible institution for climate change data and projects undertook studies based on observations. The most comprehensive work on climate change trends and projections is the Analysis of Historical Climate and Climate Change (2019) prepared by NCHM, which is referenced in the Third National Communication (2019) and also by other climate change studies and reports on Bhutan, and is also the basis for the discussion below.

3.1.1. Historical Climate Trends and Projection

The Historical Climate Data Analysis and Climate Change Projection for Bhutan analyzes future temperature and rainfall changes using *multi-model ensemble (MME)* of five global climate models (CMIP5). The dataset contains downscaled climate scenarios derived from the General Circulation Model (GCM) runs conducted under the Coupled Model Inter-comparison Project (CMIP)5 and across two of the four greenhouse gas emissions scenarios, Representative Concentration Pathways (RCPs). The NEX-GDDP (NASA Earth Exchange Global Daily Downscaled Projections) datasets include downscaled projections for RCP 4.5 and RCP 8.5 from the 21 models and scenarios for which daily scenarios were produced and distributed under

[4] GIZ, 2016, SNAP: Stocktaking for National Adaptation Planning; Assessing Capacity for Implementing NDCs

CMIP5. Each of the climate projections include daily maximum temperature, minimum temperature, and precipitation for the periods from 1950 through to 2100.

The findings from the analysis of historical climate indicated an increasing trend in temperature both at mean seasonal and mean annual scales and a decreasing trend in rainfall at mean annual scales. The rainfall indicated a larger variability (see below):

Climate Projection-Temperature

- Under the RCP 4.5 scenario, the climate projection for surface temperature indicates an increase of about of 0.8°C – 1.6°C during 2021-2050 and about 1.6°C – 2.8°C towards the end of the century (2070-2099). Overall the climate projection of surface temperature under the RCP4.5 scenario indicated an increase in about of 0.8°C – 2.8°C during 2021-2100.
- Larger warming is indicated during MAM and DJF seasons. The country is expected to experience an increase in temperature with a larger increase projected in the high lands.
- Under the RCP 8.5 scenario, the climate projection for surface temperature indicated an increase of about 0.8oC – 2.0°C during 2021-2050 and increase of about 3.2°C towards the end of the century (2070-2099).

Climate projection-Rainfall

- The mean annual rainfall over Bhutan is likely to increase in the future. Under the RCP4.5 scenarios, the annual rainfall over Bhutan indicates an increase of about 10%-30 in summer (JJAS) rainfall between 5% -15 %. While the increase in rainfall is likely in DJF in Bhutan, some parts of the northern and northern west are likely to experience a decrease in rainfall. During 2021-2050, Bhutan is likely to experience increasing trends in rainfall with a marginal decrease towards the end of the century (2070-2099).
- Under the RCP 8.5 scenario, the mean annual rainfall indicates an increase of about 10- 20% during 2021-2050 and with more than 30% increase all over Bhutan towards the end of the century. While the projections suggest increasing rainfall during the JJAS, the winter (DJF) seasons are likely to receive a decrease in rainfall in some parts of the country, in the northwestern region of Bhutan. A marginal increase in rainfall trend is indicated under the RCP 8.5 scenarios[5].

3.1.2. Other studies

In addition, the NCHM publishes the annual Climate Data Books (Vol I & II) containing climatological records and precise summary of climatological information for selected meteorological stations across the country from 1996 onwards. The data books include monthly summary on rainfall, temperature, and humidity parameters based on the available data archived for the past years.

Across models, there is consistent finding on a warming pattern across Bhutan, with greater change projected for the winter season. In the case of rainfall, majority of models predict an increase in annual rainfall, although one model (ECHAM5) show a decrease. Practically all models agree on a projected rise in temperature. Three quarters (75th percentile) of the more than 40 GCMs used by the IPCC in its Fifth Assessment Report agree that the average temperature over Bhutan during winter (December to February) is likely to increase by up to 1.5°C in 2016-2035, and by up to 3.0C in 2046-2065 under RCP 4.5. [6]

Based on the downscaled MRI-CGCM3 model for RCP 4.5, the average temperature across the country is projected to change from a range of -1.07°C (low) to 23.25° C (high) in the 2030s, to a range of 0.47°C (low) to 24.48° C (high) during the 2090s.[7]

In the case of precipitation, the MRI-CGCM4 model for RCP 4.5 projects that the average annual precipitation in millimeters across the country would change from a range of 329 (low) to 3,575 (high) in the 2030s, to a range of 349 (low) to 3,668 (high) during the 2060s. The CCSM4 model for RCP 4.5 projects that the average annual precipitation in millimeters across the country would change from a range of 350 (low) to 3,400 high (high) in the 2030s, to a range of 363 (low) to 3,475 (high) during the 2060s. Daily precipitation projections from the MRI-CGCM3 model, in particular, were used as inputs to the HEC-HMS hydrologic model in order to

[5] NCHM, Analysis of Historical Climate and Climate Change Projections
[6] NCHM, Analysis of Historical Climate and Climate Change Projections
[7] NCHM, Analysis of Historical Climate and Climate Change Projections

examine the future impacts of climate change on river flows (low flows and flood flows) for the major river basins in Bhutan. The results of the hydrologic impact modeling derived from the MRi-CGCM3 climate change projections are described in a separate report.

3.1.3. Weather Forecasting

The NCHM is the responsible authority for collecting daily weather and seasonal climate information. It does so in the following:

- NCHM provides 24 to 72 hours weather forecast and seasonal climate information
- NCHM does not have capacity to provide impact based forecast information.
- Weather monitored 24/7
- Extreme weather events (cyclone, thunderstorm, snow, heavy rain) forecast information are issued via press release and information disseminated via social and mainstream media.

3.1.4. Hydro-meteorological data and early warning

The hydro-meteorological services started as early as 1990. Currently the NCHM provides the following Early Warning Systems (EWS):

- GLOF and rainstorm early warning system based on 10 AWLS (Automatic Water Level Sensors) & AWS (Automatic Weather Stations), and 18 sirens in the Punatsangchu basin
- GLOF rainstorm EWS based on 3 AWLS & AWS with 6 sirens in Chamkharchu basin.
- GLOF rainstorm EWS based on 2 AWLS & AWS with 3 sirens in the Mangdechu basin.

3.1.5. Overall Availability

At present the assessments conducted by NCHM use a spatial resolution of about 1 km^2 (a resolution grid of 30 arc-sec). The recently released Bhutan Glacier Inventory, 2019 used Sentinel-2 MSI (Multispectral Instrument) of European Space Agency (ESA) to develop high-resolution imagery considering an area threshold of 0.01 km^2. While there is a gap in terms of historical data availability and gewog level projection studies, this gap is not critical enough to justify the NAP process pausing to address this; the gap can be filled even as the NAP process moves on to the next stage. It is rather more required to develop climate vulnerability and risk assessments for identified sectors at dzongkhag level.

It is important to note that the spatial resolution at which climate information is required is largely determined by the purpose of the assessment. For example, if it is designed to assess the risk of livelihood insecurity due to climate change, information at the existing climate model resolution (i.e. national level) may be sufficient. But if the assessment is intended to support adaptation planning at an operational level, for instance, to augment water supply policies, climate information of higher resolution maybe required. Therefore, at the planning stage (NAP process) climate information is often required at national or at most dzongkhag scale and at monthly to seasonal timescale.[8] The existing observed datasets, GCM outputs and downscaled scenario products can largely meet the needs for this purpose. However, when resources and technical capacity permit, additional work could be undertaken to produce climate information at higher resolution (both in spatial and temporal terms), while taking into consideration that the benefits of this information are likely to exceed the costs of producing it. As the time period for such studies may be longer than the NAP process calendar, so the findings may not feed into NAP.

On similar lines, for NAP it is recommended 30-year period from 1960 to1990 to represent a baseline climate, and a projection beyond 1990 to represent a changed climate. However, even with the current level of downscaling and emission scenarios that are available it is possible to move ahead with adaptation planning. As it is only required to have broad consensus about climate change and its likely impacts, even if the projections have limitations for planning.[9]

[8] Applying Climate Information for Adaptation Decision-Making, 2015, UNDP, UNEP, GEF
[9] Technical guidelines for the national adaptation plan process, 2012, UNFCCC

3.2. Sector-wise climate change vulnerabilities and impacts

3.2.1. Water resources and energy

There are multiple studies on the water sector in Bhutan. These also explore climate change impacts on the sector. Major water sources for Bhutan includes glaciers, lakes, marshes, springs, streams, and rivers. Glacial melt is estimated to feed 2-12% of the river flow and 2% from snow melt. The total annual flow for the country is estimated to be around 70,576 MCM. Bhutan has about 3182 rivers and rivulets within its territory based on a 90x90 m SRTM DEM on a 1:1,500,000 Map with a total length of 4741 km. Almost 88% of the total precipitation is concentrated in the monsoon and pre-monsoon months which contributes to a major portion of the water volume. Bhutan has five main river basins namely Amochhu, Wangchhu, Punatsangchhu, Mangdechhu and Drangmechhu and five minor river systems. The Punatsangchhu basin is the largest with an area of 9,645 km², around 25% of the country's total land area[10].

Bhutan's major economic use of water is for the generation of electricity. It has a theoretical potential to generate 30GW of hydroelectricity, of which 23.8GW is said to be technically and economically feasible for development. By 2020, Bhutan is expected to have a total installed generating capacity of 5,264MW from the existing five hydropower projects and 3,658MW scheduled to be commissioned.[11]

An assessment carried out by the NEC (2011) using Water Evaluation and Planning (WEAP) Software Package (NEC, 2011) highlighted increasing water demand:

- There is increased water demand in the future for municipal, rural and irrigation use.
- Agriculture continues to demand more water than Municipal areas and Industry.
- Water demand for all 3 sites (Thimphu, Paro and Haa) will be met, but projections (2010-2039; and 2040-2069) show an increase in water demand as most of the population depends on water from springs and smaller streams for drinking and irrigation.

Table 1: Current and future water demand by sector

Sectors by Use	Population/total irrigated area (Ha)	Drinking water demand LPCD (Litres Per Capita per Day)	Water required 2017 (MCM/Yr)	Projected Population in 2050	Water Demand LPCD (Litres Per Capita per Day)	Water Required 2050 (MCM/Yr)
Drinking water	727,145	150	39.81	1,039,090	300	113.78
Industry & others	-	-	74.39	-	-	218.35
Irrigation water	25011	-	666.9	-	-	911.8

(Source: Draft V&A for Third National Communication, 2019)

The National Integrated Water Resources Management Plan 2016 (NIWRMP) gives an overview of the dual nature of water resource issues - the problem of plenty and scarcity at temporal and spatial scales. The existing issue will be exacerbated by climate change resulting in higher temperatures and more erratic and intensive rainfall during the monsoon – when water is already plentiful. Extreme river discharges are expected to occur;

[10] Draft V&A for Third National Communication, 2019
[11] NTGMP 2018, MOEA, https://www.moea.gov.bt/wp-content/uploads/2018/11/National-Transmission-Grid-Master-Plan-2018.pdf

and conversely, lean period flows are expected to be lower. The increase magnitude and frequency of precipitation will overcharge the water resources causing many water related disasters, such as floods, landslides, typhoons and cyclones. On the other hand, decrease in the magnitude and frequency of precipitation and, temperature increases are likely to cause decrease in water discharge, decrease in the level of water in the natural aquifers and drying of water resources.[12]

The most significant impact of climate change on water resource is the drying of water resources such as lakes, ponds, springs and marsh lands that feed the streams on which the local population depend for their water needs. All dzongkhags have reported drying up of water sources and acute water shortages for drinking while there is an increasing fallowing of agricultural land in the rural communities. Assessment of water sources across the country found 35 % (2317) of the water sources from 6555 water sources in drying condition and 2 % (147) in dried-up condition with highest number of drying and dried-up water sources in Samtse Dzongkhag.[13]

The "Climate change impacts on the flow regimes of rivers in Bhutan and possible consequences for hydropower development", 2011 assessed the impacts of climate change on the hydrological regime of rivers (stream flow) from 17 catchment areas, for hydropower production based on projected changes in temperature and precipitation, glacial mass and its contribution to streamflow from glacier ice melt.[14] It noted changes in mean annual temperature, precipitation, glacier mass balance, streamflow, changes in annual discharge for hydropower production:

- The change in mean annual temperature from 1981 to 2050 averaged over the area is approximately 1.4 °C, and the change in mean annual temperature from 1981 to 2100 is 2.5 °C and 4.9 °C for each of the two emission scenarios for greenhouse gases, respectively.
- The changes in mean annual precipitation sums from 1981-2010 to 2021-2050 and 2071-2100 are mostly negative and the changes in precipitation are larger by the end of the century than by the middle. Large negative changes are more frequent in southern parts of Bhutan.
- Glacier mass balance is negative for most areas for the period 1981-2100, resulting in decreasing glacier ice volumes and glacier covered areas. Until the middle of the 21st century negative glacier mass balance is not sufficiently large to melt more than small fractions of the glacier covered areas completely, but by the end of the century large areas that are glacier covered at present will be completely devoid of glacier ice. The contribution to streamflow from glacier ice melt water will remain mostly unchanged during the first half of the 21st century, while it will diminish during the second half.
- For most catchment areas streamflow is not changing much from 1981-2010 to 2021-2050. However, as a result of smaller precipitation amounts, during summer, there is a reduction in streamflow for catchments with small glacier covered fraction since they will not receive a contribution to runoff from melting ice. The catchments with largest glacier covered fraction will experience increased streamflow caused by increased contribution to runoff from glacier ice melt. For the period 2071-2100 there is a decline in precipitation compared to the period 1981-2010. In combination with a reduction in glacier volume and area this leads to a large reduction in streamflow. Catchments with a negligible glacier covered fraction will also experience reduced streamflow, but this is a result of precipitation change.
- The change in mean annual discharge available for hydropower production from 1981-2010 to 2021-2050 varies between 13 % decrease and 7 % increase for all catchments and both emission scenarios for greenhouse gases.
- The change in mean annual discharge available for hydropower production from 1981-2010 to 2071-2100 is influenced by reduced contribution to streamflow from glacier ice melt. This leads to a decline in mean annual discharge available for hydropower production compared to the period 1981-2010 varying from -76 % to -4 %, the rate of change depending on the initial ice-covered fractions of the catchments.
- Hydrological model simulations with constant glacier covered areas show a strong increase in streamflow and mean annual discharge by the end of the 21st century as a result of increasing

[12] RNR Sectoral Adaptation Plan of Action (SAPA, 2019), MoAF
[13] Draft V&A for Third National Communication, 2019
[14] Climate change impacts on the flow regimes of rivers in Bhutan and possible consequences for hydropower development, 2011

temperatures leading to higher glacier ice melt rates. Until the middle of the century there is only a small difference between the two sets of model results, as model simulations with time-variant glacier covered areas have only led to a small reduction of glacier ice volume and area.

- The annual cycle of meteorological processes in Bhutan will not change during the 21st century. At high altitudes temperature will remain below freezing point during the winter and precipitation will accumulate as snow. The annual cycle of streamflow follows the same pattern as in the present climate with low flow during winter and high flow during summer as a result of the combined effect of snowmelt and larger amounts of precipitation in the summer season than in the rest of the year. There is a relatively small change in the magnitude of streamflow until the middle of the 21st century, whereas changes are larger by the end of the 21st century due to reduced contribution from melting of glacier ice.

Risk and Impact Assessments

A climate risk assessment of Dagachu studied the hydrology stability and impacts of climate change in the hydrological regime of Dagachhu watershed with outputs on land-use, soil data, elevation, precipitation, stream flow/discharge. The study concluded that the Dagachhu hydropower plant is hydrologically sound. It has low risks relating to climate change impacts in technical, financial, social, and environmental terms. Overall climate change is unlikely to impose negative effect on Dagachhu hydropower plant.

A water security index and baseline for Wangchu basin is available with specific status of water resources and their related services in 5 key dimensions. *The Bhutan Water Security Index (BWSI)* determines to what degree water resources and their related services are developed, as measured over five key dimensions that provides the framework for planning, monitoring and inter-agency coordination.

- Rural drinking water supply, sanitation and hygiene
- Economic water supply for agriculture, industries and hydropower
- Urban water supply, sanitation and drainage
- Environmental water security
- Disaster and climate change resilience

3.2.2. Glaciers, Glacial Lakes & Glacial Lake Outburst Floods

Bhutan is undergoing warming at an unprecedented rate with evidences suggesting higher warming trends during winter months and at higher altitudes. Several remote sensing- based studies have suggested glaciers in Bhutan are melting with evidences suggesting oldest stage of glaciers in Bhutan extended down to 2600 m.a.s.l (Elevation in meters above sea level). whereas in the present day, they are found only above 4000 m.a.s.l. Glacial retreat in Bhutan has been extensive leading to formation of supra-glacial, pro-glacial and moraine dammed lakes. Particularly in Bhutan and Eastern Himalayas, threat from glacial lake outburst floods is high.[15]

A compendium of climate and hydrological extremes in Bhutan is a collection and archive of past extreme weather and flooding events recorded in Bhutan since 1968. The publication is an inventory aimed at carrying out long-term analysis of flood occurrence, intensity/severity, temporal and spatial variations of events and their underlying meteorological causes over time and improve understanding of flood risks and flood hazard mapping in Bhutan.

Historical records of glaciers and glacial lake studies in Bhutan dates to 1960s and 1970s carried out by Gansser in Lunana which first identified several dangerous lakes that could flood lower valleys including Raphtsreng tsho. Subsequent surveys and mappings were carried out by joint expeditions:

In 1998, a Japan-Bhutan joint research team carried out an assessment of GLOFs in Bhutan and compiled an inventory of glacier lakes. In addition to the inventory, the joint research installed three AWS in Lunana and carried out a risk assessment on glacier lake outburst floods examining historical variations of glacier lakes

[15] Mahagaonkar, A., Wangchuk, S., Ramanathan, A., Tshering, D. and Mahanta, C. (2017). Glacier Environment and Climate Change in Bhutan—An Overview. Journal of Climate Change, 3(2), pp.1-10.

and glacier termini using photographs, satellite images, maps and published observations. Glacier lakes were classified into three types based on location, mode of formation and recent condition:

- *Supraglacial ice-melt ponds or lakes:* most of them are small and shallow in size, but they tend to connect to each other and grow into large contiguous lakes.
- *Moraine-dammed lakes:* some lakes store large quantities of water and have probability of GLOFs that could cause severe damage downstream.
- *Lakes located in basins far from glaciers or without glaciers:* they are in cirques or glacial troughs which were scoured by Pleistocene glaciers. These lakes are stable because of solid rock spillways and no direct influence of glacier variation. In the northern region of Bhutan, supraglacial ponds on some debris-covered glaciers in the 1950s have subsequently grown into moraine-dammed lakes. Also, proglacial lakes have expanded substantially as a result of retreat of glacier termini.

In 1999, an Austria-Bhutan expedition carried out integrated geophysical, hydrological, and geological investigations in Lunana area with special emphasis on Taphstreng Tsho and Thorthomi Tsho. The study concluded then that risks from outburst from Raphstreng was low, while risks from Thorthormi lake was considered high given the trend of climate change.[16]

The Department of Geology and Mines in collaboration with ICIMOD updated the Geological Survey of Bhutan and published the first glacier inventory titled 'Inventory of Glaciers, Glacial Lakes and GLOF in Bhutan 1999 using remote sensing and geographic information systems. Altogether, 2674 glacial lakes were identified of which 24 were deemed as potentially dangerous lakes (PDGL): three lakes belong to the Chamkhar Chu Sub-basin, one lake to the Kuri Chu Sub-basin, seven lakes to the Mangde Chu Sub-basin, five lakes to the Mo Chu Sub-basin, and eight lakes to the Pho Chu Sub-basin. The study concluded that the risk for an outburst from Raphstreng was low, but the risk of an outburst of Thorthormi Glacial Lake in the future is considered high and it could occur in 15–20 years considering the trend of climate change. [17]

The *Bhutan Glacier Inventory 2018* is the most recent update on glaciers in Bhutan using the latest available high-resolution satellite imageries (Sentinel-2 MSI of European Space Agency) by national experts. Along with the BGI 2018, a report om the reassessment of PDGL reported that out of 25 dangerous glacial lakes previously identified in 2001, 8 were categorized safe based on lake morphology, its surrounding features, bathymetry condition and associated feeding glacier, 5 lakes were not ground verified and 12 were identified as potentially dangerous. From the recently updated list of PDGLs, 17 glacial lakes were verified as PDGLs by the NCHM in their recent study. Out of the 17, 9 are in Phochhu basin, 2 in Mochhu basin, 3 in Mangdechhu basin, 2 in Chamkharchhu basin, and 1 in Kurichhu basin. The higher number of PGDLs in the Phochhu basin and major GLOF events in the past makes it vulnerable to the risk of GLOFs.[18]

3.2.3. Infrastructure and Disaster Risks

Bhutan is vulnerable to natural hazards such as floods, landslides, forest fires, droughts, cyclones and windstorms due to its rugged and fragile mountain terrain, complex geological setting, high intensity of seasonal rains, and active tectonic processes taking place in the Himalayas (Ministry of Home and Cultural Affairs Bhutan, 2005). These hazards are likely to become more frequent and more intense with changing patterns of temperatures and precipitation. Landslides and mudslides are a recurring phenomenon in Bhutan mostly triggered by intense rainfalls on fragile and steep topography during the monsoons. Most landslides tend to occur in the eastern and southern foothill belts where the terrain is steep and rocks underlying the soil cover are highly fractured, allowing easy seepage of water. Both urban centers and rural communities that are dependent of critical infrastructures such as roads, bridges, public buildings, water tanks, electricity and communication infrastructures which are susceptible to floods and landslides. For instance, on May 25th and

[16] DGM, (1996) Glaciers and Glacier Lakes in the Headwaters of Major River Basins of Bhutan
[17] Häusler, H.; Leber, D.; Schreilechner, M.; Morawetz, R.; Lentz, H.; Skuk, St.; Meyer, M.; Janda, Ch.; Burgschwaiger, E. (2000) *Final Report of Raphstreng Tsho Outburt Flood Mitigatory Project (Lunana; Northwestern Bhutan): Phase II*. Vienna, Austria: Institute of Geology, University of Vienna
[18] Bhutan Glacier Inventory 2018

26th, 2009, Cyclone Aila brought unprecedented rain inducing severe flooding in seventeen of the twenty districts with an estimated damage worth USD 17mn.[19]

The Flood Engineering and Management Division, Ministry of Works and Human Settlement carried out Flood Hazard Assessments for 19 Dzongkhags. It included detailed flood assessment of each dzongkhag, analysis of the AoMI (Areas of Mitigation Interest), identified and prioritized critical flood prone areas with a set of recommendations for appropriate flood protection measures along the identified flood prone areas.

The Department of Geology and Mines (DGM) carried out integrated geo-hazard risk assessments and mapping of the four critical landslides; and landslide monitoring and threshold development of six landslides between 2014 and 2017. The assessments engaged topographical survey, geological mapping, engineering geological mapping, geophysical survey, and hazard and risk assessment. The objectives were:

(i) to map and assess four critical landslides affected areas and provide a set of recommendations for short to long term sustainable remedial measures

(ii) record and monitor landslides to understand the movement behaviors

(iii) develop rainfall thresholds for landslide initiation; forecast or issue landslide warnings

(iv) share finding and recommendations with relevant users.

(v) Integrated geo-hazard risk assessment of four critical landslide at (i) Arong/Lamsorong, Samdrupjongkhar-Trashigang Highway, (ii) Moshi, Wamrong, Trashigang, (iii) Barsa watershed under Phuntsholing Dungkhag, Chukha Dzongkhag, and (iv) box cutting landslide on Gelephu-Zhemgang highway.

(vi) Landslide monitoring and threshold development of six landslides (i) Arong/Lamsorong, (ii) Moshi, Wamrong, (iii) Lem landslide, Trashigang, (iv) box cutting landslide, (v) Tshimatsham, Chukha Dzongkhang, and (vi) Reldri landslide

Since 2013, the MoWHS carried out geotechnical studies and hazard mapping for valley development planning.

Climate change has the potential to cause significant disruptions and damage to transport systems particularly to the road network. The most common climate induced hazards that could directly impact the road and associated infrastructures are landslide, floods, and landslips, deposition of boulders and debris, deformation of topography and destabilization of the delicate steep slopes. Topography is by far the most significant factor that predisposes the road network to climate change induced disasters. As part of the project on “Enhancing sustainability and resilience of forest and agriculture landscape and community livelihoods in Bhutan (2017-2023)”, an assessment on the existing status of 14 Gewog Connectivity (GC) roads outlined the underlying vulnerability factors including fragile and rugged mountain terrains.

3.2.4. Agriculture and Livestock vulnerabilities and climate impacts

The agricultural sector is central to the Bhutanese economy accounting for over 20 percent of Bhutan’s GDP; and 54 percent of the total labor force is engaged in agriculture activities.[20] Of the total labor force in the sector, 46.4 male and 63.2 female population are engaged in farming practices. However, farming practices are predominantly at subsistence levels, and a majority continue to grow traditional crops and crop varieties on small land holdings and difficult terrains. Majority of the farmers are also dependent on erratic seasonal monsoons leading to food security problems. Although livestock rearing is part of the farming system in Bhutan supplementing cropping practices, farmers face challenges in terms of loss of cattle to predators, fodder availability, and labor shortages due to increasing rural-urban migration.

Impacts on Agriculture and Livestock sectors

The projected climate change scenarios for Bhutan could further impact agriculture sector mainly due to decrease in water availability for irrigation, incidence of pest and diseases, temperature extremes resulting in

[19] (DDM, 2016).
[20] MoHLR, 2018

drought or frost, windstorms and flashfloods affecting both crops and land use. In livestock production system, the major threat of climate change will be on the degradation of natural resource base supporting livestock production such as reduction on feed, fodder and water availability which could ultimately impact livestock production that remains as the key component of food security.

Pest and diseases have a major impact on agricultural productivity in Bhutan. Most outbreak of pests and diseases in major crops of Bhutan (e.g. rice, maize, wheat, potatoes and chilies) are influenced by climate conditions, with most damages occurring with early monsoon onset. Some of the major crop diseases are Grey Leaf Spot (GLS), Turicicum Leaf Flight (TLB), Potatoes Tuber Motn (PTM), Rice Blast. The National paper on biodiversity persistence and climate change at the Climate Summit 2011 reported the following impacts: Flash floods, hailstorms, and extreme weather events cause considerable damage to crop, and during harvest season can result in the loss of an entire crop. For example, in 2013 cyclone Phailin caused massive losses to rice crops in Paro when it hit the region in October when most farmers had harvested their crop and left it in the field to dry. The period of greatest risk for extreme rainfall events is in the summer monsoonal months. In the south western regions this risk is greatest in June, whereas in the south eastern regions the greatest risk is in July. The monsoon rains and those from cyclonic events are the main trigger for flooding events especially in southern regions of Bhutan where the landscape is conducive to flash flooding: that is, deeply eroded, steep and closely spaced gullies, gorges and river valleys, combined with low permeability or saturated soils.[21]

In March 2009, avalanches killed 20 yaks in the northern part of Sephu Gewog. Local people blame the avalanches on the warming of the snow, which, at a higher temperature, cannot cling to mountains. The frequency of smaller avalanches has increased in the northern part of Chhokhor Gewog, destroying trails and depositing debris.

3.2.5. Forest and biodiversity

About 72% of the land area in Bhutan is covered by forests of temperate and sub-tropical species that are a natural habitat for diverse flora and fauna. Bhutan has one of the richest bio-diversities in the world, with about 3,281 plant species per 10,000 square kilometres, and has been declared as part of one of the ten global biodiversity hotspots.[22]

Impact on Forest and Biodiversity

Occurrence of forest fires, loss of biodiversity, shifts in habitats, occurrence of pests and diseases and overall decline in ecosystem services of the environment are challenges that the forests and biodiversity sector confront. Available literature indicates that due to the changes in temperature and rainfall patterns, there have been visible changes in the pattern of biodiversity as indicated in the following tables on observed changes in flowering time of plant species and observed changes in population of animal species.

Bhutan has a total forest cover of 70.46% (excluding shrubs), comprising of 62.43% broadleaf; 22.69% Mixed Conifer; 6.77% Fir; 3.98% Chirpine; 2.96% Blue pine and 1.16% Broadleaf with conifer. The Shrubs constitute 10.81% (LCMP, 2010)[23]. The climate change impact on biodiversity includes significant changes in forestry, wildlife and land resources.

Within the areas of Wangchuck Centennial Park, community livelihoods based on pastoralism and agriculture are indicated to be affected by new diseases, pests, and parasites and by shifting phenological and seasonal changes induced by climatic changes. As a result, vulnerability at a community level, particularly among subsistence farmers, is high.[24]

A survey in 2010 indicated that the productivity of *Abies densa*, *Pinus wallichiana*, *Quercus glauca* and *Quercus griffithii* forests suffered set-backs due to periodic diebacks and insect attacks. It also indicated that pests and diseases in forests and agriculture had increased over the years in general.

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[21] Pillai, Poonam; Tshering, Dechen; Abawi, Yahya; Wang, Sonam. 2016. *Strengthening Agro-Met Services in Bhutan (English)*. Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/367871546582390434/Strengthening-Agro-Met-Services-in-Bhutan

[22] Bhutan Climate + Change Handbook (2016), Thimphu, Bhutan: Bhutan Media and Communications Institute. - 130. p

[23] Bhutan Land Cover Assessment 2010, MoAF, http://www.nssc.gov.bt/wp-content/uploads/2013/08/land-cover.pdf

[24] Lhendup P, et al, WWF, 2011

There were outbreaks of bark beetle in spruce forests, increased incidence of mistletoe infestation, and moisture–stress related problems in blue pine forests. In less than 16 years (1992-2008), five incidences of pine diebacks were observed (1994, 1999, 2001, 2003 & 2008) along the Paachu-Wangchu valley. A study in 2009[25], found that pine dieback was strongly correlated with higher temperature and lower rainfall during the die-back incidences in the area.

Climate Change Vulnerability Assessment of Wangchuck Centennial Park in 2011 deduced a warming trend in annual temperature and high levels of variability and uncertainty in annual precipitation, which will lead to shifts in seasonal stream flow, ecosystems, and distributions of species depending on habitat shifts. The deterioration of ecosystem connectivity and the increase of habitat fragmentation are identified as major sources of vulnerability for both terrestrial and aquatic ecosystems[26].

Forest fire is a recurrent phenomenon. Incidences have been on a decline from 44 incidences 2010-2011, 39 in 2011-2012 and 34 in 2012-2013. However, the number of forest fires increased from 34 in 2012-2013 destroying 12,175 acres of forest to 64 incidences destroying around 45,095 acres of forests during 2013-2014[27]. By average, the most affected Dzongkhags are Wangduephodrang, Trashigang, Monger, Lhuentse and Thimphu.

Vulnerability Assessments

The assessment on climate change vulnerabilities *'Enhancing Sustainability and Climate Resilience of Forest and Agriculture Landscape and Community Livelihoods in Bhutan'* is about the only representative field study carried out to formally establish a baseline information of adaptation responses. It analyzed exposure, sensitivity, and adaptation capacity as the principal factors of climate vulnerability in the agriculture and forest sectors. It included vulnerability indicators and maps for 36 chiwogs in eighteen gewogs across three landscapes.

- The analysis of climate vulnerability shows that landscape three, which comprises of areas within Phrumsengla National Park (PNP) and the Biological Corridor (BC4) connecting the PNP to Jigme Singye Wangchuck National Park (JSNP) is relatively the most vulnerable to climate change. It also has the highest score on Sensitivity index.
- Landscape two comprises of Jigme Singye Wangchuck National Park (JSWNP) and biological corridors connecting JSWNP connecting to Jigme Dorji National Park (BC2) and the one connecting it to Wangchuck Centennial Park (BC8) is second most vulnerable. It scores the highest on exposure index and lowest on adaptive capacity.
- Landscape one, comprising of Jigme Khesar Strict Nature Reserve (JKSNR) and the BC1 connecting JKSNR to Jigme Dorji National Park (JDNP), is the least vulnerable among the three landscapes. It has the highest score on adaptive capacity and lowest scores on exposure and sensitivity indices.

A vulnerability assessment in the Wangchuck Centennial Park (2011), also reported an increase in the emergence and spread of both existing vector-borne diseases and macro-parasites of animals and new diseases. Local people observed an increase in lice, flies, and ticks on livestock, and the incidence of foot and-mouth disease also has increased. In Tang Chudtod village, an invasive weed species (*Taraxacum officinale*) has rendered most of the livestock pastures unsuitable for grazing and for grass harvesting of hay feed for livestock during the winter.

A joint study by the International Center for Tropical Agriculture (CIAT) and the Ministry of Agriculture and Forestry (MoAF)[28] carried out an assessment of the impacts of climate change on five key crops (i.e. rice, maize, potato, chili and tomato) and three diversification crops (i.e. quinoa, kiwi and cardamom) to examine the suitability of various crops in Bhutan under different climate scenarios up to 2050. The results of the study

[25] Wangda et al.2009
[26] Climate Change Vulnerability Assessment of WCP, Lhendup P, et al, WWF, 2011
[27] Bhutan RNR Statistics, 2015, MoAF
[28] Parker L. et. al. 2017. Climate change impacts in Bhutan: challenges and opportunities for the agricultural sector. Working Paper No. 191. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

identified areas of intervention due to eminent loss of climate suitability for the crops and provided input on suitable locations to test the diversification crops and potential areas for expansion of the key crops.

Drought is a major factor in crop production and despite frequent occurrences of drought in Bhutan, there is limited data on the extent of crop losses that can be attributed to drought. Currently there are no drought monitoring and forecasting capabilities in Bhutan. The Department of Agriculture does not collect information on drought impacts.[29] An analysis of rainfall percentiles (six months accumulated values) was carried out by WB (2016) to identify periods of drought in three of the agro-climatic zones to assess the extent and severity of droughts that have occurred in Bhutan since the availability of rainfall data (1990-2014). The data shows occurrence of more than 10 drought events between 1990-2014.[30] As per the CCAFS (2017) partial data is available on windstorm/frost/ hail stone/heat stress/drought collected by NCHM.[31]

In terms of climate vulnerability, the RNR statistics, carried out periodically, provides data on crop and livestock production, losses by climate related disasters such as windstorm and flood, pest and diseases; forests and irrigation areas under climate resilient initiatives; and food self-sufficiency. Additionally, the core datasets also include crop and livestock inputs and production, RNR infrastructure and machinery, geospatial data and commodity pricing and trade data.

A rapid assessment of Human-Wildlife Conflict (HWC) was conducted in nine gewogs across four dzongkhags to develop strategies to improve HWC management and safeguard the rich biodiversity and livelihoods of local communities. Overall, the results from the rapid assessment reveal that while wildlife and their habitats are safe, while people and their assets are unsafe in Bhutan. The assessment reports increased depredation of crops and human casualties[32].

In addition to the nation-wide surveys on tiger and snow leopard, the Department of Forests and Park Services conducted the national elephant survey. The surveys reported on the status and distribution of the species with information on habitat use and suitability in relation to environmental and anthropogenic variables.

3.2.6. Climate change vulnerabilities and Human Health

Human health is profoundly affected by weather and climate. Climate change threatens to exacerbate today's health problems – deaths from extreme weather events, cardiovascular and respiratory diseases, infectious diseases and malnutrition – whilst undermining water and food supplies, infrastructure, health systems and social protection systems (WHO, Climate Change Country Profile). Bhutan already suffers from high rates of a series of climate-sensitive health burdens. With increase in the temperature and resulting increases in the geographic range and incidence of vector-borne diseases, a wide range of health risks associated with the changes is also projected to increase. Some of the increased risks are given are:

- Loss of life from the probability of glacial lake outburst floods, flashfloods and landslides.
- The geographical range and incidence of vector-borne diseases, particularly malaria and dengue. Dengue is an emerging infectious disease in Bhutan; it was first documented in the country in 2004 and is now endemic during the monsoon period. Increasing temperatures are complicating control of vector-borne diseases in Bhutan. Two types of malaria are prevalent in Bhutan: the more severe *Plasmodium falciparum* (30-60% of cases) and *Plasmodium vivax* with over 50% of the population residing in malarial areas. Dengue is an emerging infectious disease in Bhutan;
- The incidence of waterborne diseases due to drying up of water sources or contamination from flooding. Diarrheal diseases represent a significant cause of morbidity in Bhutan for the last

[29] Pillai, Poonam; Tshering, Dechen; Abawi, Yahya; Wang, Sonam. 2016. *Strengthening Agro-Met Services in Bhutan (English)*. Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/367871546582390434/Strengthening-Agro-Met-Services-in-Bhutan
[30] Pillai, Poonam; Tshering, Dechen; Abawi, Yahya; Wang, Sonam. 2016. *Strengthening Agro-Met Services in Bhutan (English)*. Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/367871546582390434/Strengthening-Agro-Met-Services-in-Bhutan
[31] Parker L. et. al. 2017. Climate change impacts in Bhutan: challenges and opportunities for the agricultural sector. Working Paper No. 191. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)
[32] MOAF, 2016, Human Wildlife Conflict SAFE Strategy

decade and contribute to about 10-15 % of morbidity cases. Climate change has also influenced water resources due to drying up of water sources or contamination due to flooding, increasing the risk of diarrheal disease.

An assessment of health vulnerability and adaptation to climate change developed the baseline to understand the health impacts of climate change and the adaptive capacity; generate better information, data collection and surveillance of climate change-related health risks in Bhutan to improve early warning, preparedness and response to potential health risks[33] and the climate change health profile for Bhutan conclude the following:

- In Bhutan, under a high emissions scenario heat-related death in the elderly (65+ years) are projected to increase to about 49 deaths per 100,000 by 2080 compared to the estimated baseline of zero deaths per 100,000 annually between 1961 and 1990.
- It is projected, that by 2030, under a high emissions scenario, an additional 7,600 people may be at risk of river floods annually as a result of climate change and 2,400 dues to socio-economic change above the estimated 3,100 annually affected population in 2010.
- Climate change, through higher temperatures, land and water scarcity, flooding, drought and displacement, negatively impacts agricultural production and causes breakdown in food systems. These disproportionally affect those most vulnerable people at risk to hunger and can lead to food insecurity. Vulnerable groups risk further deterioration into food and nutrition crises if exposed to extreme climate events. In Bhutan, the prevalence of stunting in children under age 5 was 33.6% in 2010, the prevalence of underweight children and wasting in children under 5 was 12.8% and 5.9%, respectively, in 2010.

3.3. Adaptation strategies

There has been a technology needs assessment for Bhutan conducted that identified adaptation options for three top priority sectors. These were water resources, agriculture and natural hazards and infrastructure. Within these sectors a list of shortlisted technologies in each of the three sectors was prepared. The technological needs assessment was a process to identify, evaluate, and prioritize technologies that fit in the overall development context, while allowing the country to mitigate climate change and plan the Technology Action Plan for identified technologies. The process focuses on prioritizing technologies for each of the prioritized sector. In the water resource sector, technologies prioritized are micro/mini hydro power, efficient irrigation methods, solar power (photovoltaic); the agriculture sector prioritized agro-forestry, development of drought resistant and pest resistant crop varieties, and sloping agriculture land technology (SALT); the natural hazards and infrastructure prioritized real-time weather stations and forecasting, climate resilient roads, and community based EWS.

Besides the identification of these technologies/adaptation options there have been multiple national adaptation strategies such as NAPA that have implemented adaptation initiatives. These actions and tentative outcomes have been later elaborated in Section 5: Implementation.

[33] DPH 2012, Assessment of health vulnerability and adaptation to climate change

4. Long term vision and mandate

A long-term vision or mandate demonstrates an acknowledgement by a country's government that climate change is a priority, usually reflected in national policies and strategies, or the existence of a climate change strategy and/or plan. A long-term vision and mandate endorsed at the highest political level supports all the other 6 success factors. A long-term vision and mandate mobilize institutional planning and the support needed for the NAP process, and provides the basis for technical and financial resources to be allocated to adaptation.[34] It also sends a signal of political intent to the private sector and civil society who are critical to the overall NAP.

The aim of stocktaking for a long-term vision and mandate is to examine:

- The existence of a coherent official national plan or strategy for climate change that includes adaptation or the extent to which adaptation is recognised in a government's development plans and strategies;
- The extent to which the country's official climate change and/or adaptation strategy takes into account the impacts of climate change in the medium and long term;
- The extent to which there is a sufficient and clear mandate to carry out national climate change adaptation planning. (GIZ, SNAP, 2016)

4.1. Institutional arrangements for climate governance

Bhutan has an existing institutional framework to coordinate all matters relating to the environment including climate change. The NEC chaired by the Hon'ble Prime Minister is the highest cross-sectoral environmental policy and regulatory body responsible for coordinating all the matters relating to the protection, conservation and improvement of the environment. It continues to function as the National Climate Change Committee (NCCC) providing overall guidance on climate change policy and ensure its implementation by sectors, The NEC derives its mandate from the National Environment Protection Act (2007), Water Act (2011), Waste Prevention and Management Act (2009), Environmental Assessment Act (2000) and other directives of the government. The NCCC is supported in implementing its mandates and functions through the National Environment Commission Secretariat (NECS).

The Climate Change Coordination Committee (C4) was established in 2016, with the objective of strengthening and revamping the erstwhile Multi-Sectoral Technical Committee on Climate Change. It is the technical body serving as a forum for discussion and coordination of matters related to climate change in Bhutan and makes recommendations for consideration by the NCCC/NEC. The C4 is comprised of high-level executive representation from stakeholder agencies and organizations and is chaired by the Secretary of NECS. It has 15 senior executive level members, representing governmental agencies, private sector, and civil society organizations, and is chaired by the Secretary of NEC Secretariat It will serve as the technical level review body for the NAP process and make recommendations to the NCCC for their consideration.

The central Mainstreaming Reference Group (MRG) was formed with the NEC and the Gross National Happiness Commission (GNHC) taking the lead role, to institutionalize the mainstreaming of environment, climate and poverty (ECP) concerns into planning. The group is multi-sectoral in nature with representation

[34] GIZ, 2016, SNAP: Stocktaking for National Adaptation Planning; Assessing Capacity for Implementing NDCs

from policy, planners, environment specialists, finance experts and NGOs seen as a relevant body to provide expertise on policy making, advocate cross cutting issues at all levels of planning and implementation. As of June 2016, 20 local MRGs have been established in all 20 districts to facilitate mainstreaming of cross cutting issues in the LG development plans and programmes.

Climate data and information

The National Center for Hydrology and Meteorology (NCHM) is mandated to provide national source of hydro-meteorological data, service and advice to meet the needs of the general public, emergency services and other specialized users. NCHM will provide hydro-meteorological data and information, climate modelling and scenarios and other early warning services.

Key sectors and line agencies are currently implementing climate change adaptation into their sectoral plans and policies either through the development plans or funded projects. This includes targeted sectors such as the renewable natural resource sector, health, infrastructure development sector, and local governments.

4.2. Legislative and regulatory framework for adaptation

4.2.1. Environmental Acts and Regulations

National Environment Protection Act, 2007

The National Environment Protection Act, 2007 is the umbrella legislation that sets out requirements for the protection of the physical and ecological environment. The act provides for the establishment of an effective system to conserve and protect environment for sustainable and equitable development including powers vested in the National Environment Commission or ensuing agencies for "laying down policies, plans and guidelines for environmental protection, sustainable development and proper utilization of natural resources" (Clause 30: Powers and functions of the Commission)

Environmental Assessment Act 2000

The Environmental Assessment Act of Bhutan 2000 stipulates the requirements for conducting environmental assessments and establishes the procedures for the assessment of potential effects of strategic plans, policies, programs and projects on the environment. It is supported by regulations, sector guidelines, and codes of practice intended to guide its implementation with measures to reduce potential adverse impacts and to promote environmental benefits. Regulations and guidelines supporting the EA Act include:

Regulation for the Environmental Clearance of Projects

The Regulation defines responsibilities and procedures for the implementation of the EA Act concerning the issuance and enforcement of environmental clearance for individual projects.

Regulation for Strategic Environmental Assessment

The regulation ensures that environmental concerns are fully considered by all government agencies while formulating, reviewing, modifying or implementing any policy, plan or program including national Five-Year Development Plans. The regulation also ensures that cumulative and large-scale environmental effects are taken into consideration and to promote the design of environmentally sustainable proposals that encourage the use of renewable resources and clean technologies

The Water Act of Bhutan, 2011 and Water Regulation of Bhutan, 2014

Following the water vision and policy, the Water Act of Bhutan, 2011 was drafted recognizing threats to water resources from climate change impacts. It ensures that "water resources are protected, conserved, and/or managed in an economically efficient, socially equitable, and environmentally sustainable manner." Keeping

in line with the internationally accepted concept of integrated water resources management, the Act prioritizes water for drinking and sanitation, agriculture and hydropower development and the same order.

Subsequently, the Water Regulation of Bhutan 2014 aims to enforce and implement the objectives and purposes of the Water Act effectively assigning specific roles and responsibilities to competent authorities. The regulation also made provisions for preparing the National Integrated Water Resources Management Plan (NIWRMP) and the River Basin Management Plan (RBMP) as mechanisms for overall basin management and to strengthen resilience against climate variabilities and anticipated climate change impacts.

Forest and Nature Conservation Act, 1995 and Forest and Nature Conservation Rules, 2006

The Forest and Nature Conservation Act 2008 (replacing the Forest Act, 1969) provides the main legal framework for protection and sustainable use of forests wildlife, and related natural resources of Bhutan. It encompasses issues related to forest management, government-reserved forests, social and community forestry, forest product trade and transport, protected areas, conservation of wildlife, soil and water. It also recognizes traditional and cultural rights of local communities to forest use and access to resources. Subsequently, the Forest and Nature Conservation Rules guides the implementation of the Act through detailed provisions on research, assessments, utilization, protection, conservation and so forth including payment for environmental services and watershed protection.

Other relevant policy and regulatory provisions for forest and biodiversity include Forest Fire Rules, Rules on Biological Corridors, 2006, Biodiversity Act, 2003 and National Biodiversity Strategy and Action Plan with respective conservation objectives.

Waste Prevention and Management Act 2009; Waste prevention and management regulations 2012

Ensuing the strategy and action plan on solid waste management, the Waste Prevention and Management Act, 2009 and the Waste Prevention and Management Regulations, 2012 were drafted as key legislative framework and guidelines for implementation.

The mines and minerals management act, 1995 and the mines and minerals management regulation, 2002

The act ensures the exploitation of mineral resources in a manner compatible with the social and economic policies of the Government of Bhutan and within the framework of sustainable development, protection of the environment, and preservation of religious and cultural heritage. The regulation sets out procedures to enable implementation of the act including, mining operations and management, restoration, monitoring and environmental regulations.

4.2.2. Climate policy context – national & sectoral

Bhutan 2020

Bhutan's Vision 2020 and the "Middle Path" along with the development philosophy enshrined in Gross National Happiness" have been vital instruments for raising the profile of environmental conservation amongst policy makers and the general public. The vision document will be updated with the establishment of a committee and a guideline to develop the vision document. The Gross National Happiness Commission (GNHC) will lead and take the vision forward with consultation processes.

The National Environment Strategy, 1998

The National Environment Strategy (NES) was developed to minimize or mitigate the impacts that are likely to result from the development processes. The NES outlines three main avenues of sustainable economic development: expanding hydropower, increasing agricultural self-sufficiency and expanding the industrial base. With changes in the socio-economic development, emerging trends in the environment, increasing concerns of global climate change, expanding roles and evolution in the institutional framework for environmental considerations, the NES is in the process of review and update. The revised strategy will consider climate change and cross-sector issues.

Climate Change Policy of the Kingdom of Bhutan 2020

The Climate Change Policy calls forth the enactment of a Climate Change Act to ensure coherent and efficient implementation of the national climate priorities in line with both the long-term vision of the country and

international obligations. The policy will provide strategic guidance and tools to identify opportunities and address challenges of climate change through efficient and effective financing, technology, capacity building, awareness and mainstreaming and integrating into national plans and policies. It will also ensure meaningful participation of all relevant stakeholders in climate change action in a coordinated and coherent manner with clear roles and responsibilities.

National Strategy and Action Plan for Low Carbon Development, 2012

The strategy outlines climate mitigation options to manage emissions from energy-intensive industries, crop production, livestock raising, municipal solid waste, road transport and so forth.

Water Vision 2025 and Bhutan Water Policy 2003

The Water Vision 20205 and Water Policy were drafted in response to the need for sustainable, integrated and coordinated management with specific provisions made to climate related GLOF and flood impacts, and need for adaptation strategies including flood management and mitigation. The vision and policy encompass all forms of water: snow, glaciers, lakes, streams, rainwater, wetlands and rivers. The policies also envision that "water will continue to be available in abundance to pursue socio-economic development in Bhutan." That "present and future generations of Bhutanese people will have assured access to adequate, safe, and affordable water to maintain and enhance the quality of their lives35. The policies recognize (i) sustained flow of good quality water and therefore places an emphasis on water resource management within river basins and aquifers, including upstream and downstream water users; (ii) call for an integrated approach to the management of water resources and provides a directive to protect all forms of these resources; and (iii) seek sound watershed management through extensive soil conservation, watershed area treatment, conservation of forests and increasing the extent of forest cover in order to reduce the incidence and intensity of floods; (iv) encourages sharing of burdens and benefits of both women and men.

National Forest Policy (1974, 2010)

The National Forest Policy, 2010 is a guiding policy framework for forest resource management and conservation recognizing the role of climate change mitigation and adaptation. The framework provides for scientific management of the country's forests, and lays out approaches for forest conservation, afforestation, resource surveys, utilization, wildlife management, recreation, forest administration and training investments and government revenue, forest research and publicity.

Integrated solid waste management, 2007 (national strategy and action plan)

The strategy and action plan were drafted to address the increasing solid wastes, particularly in the urban sectors and promotes mechanisms through public-private partnerships. It provides guidance on how wastes have an impact on public health and the environment and how it may be managed efficiently and affordably.

Table 2: Policy and legislation relevant to climate change

Title	Relevance to Climate Adaptation	Year publication came into effect
Bhutan 2020	Overall guiding policy on development and a vital instrument for raising the profile on environmental conservation among policy makers.	
National Environment strategy and action plan for low carbon development (2012)	The strategy outlines climate mitigation options to manage emissions from energy-intensive industries, crop production, livestock raising, municipal solid waste, road transport and so forth.	2012
National Environment Strategy	The National Environment Strategy (NES) was developed to minimise or mitigate the impacts	1999

[35] RGOB, 2003, Bhutan Water Policy, 2003

	that are likely to result from the development processes	
Water vision 2025 and water policy (2012)	The documents encompass all forms of water and envisions access to water at an inter-generational level. There are specific provisions made to climate change and its impacts especially on GLOF and flood impacts and therefore a need for adaptation strategies.	2012
Water Act, 2011 and Water Regulations, 2014	Legislative provisions for water resource protection, conservation, and efficient, socially equitable, sustainable management in adherence to the integrated water resource management concepts.	2011 (Water Act) 2014 (Water Regulations)
National Irrigation Policy (1974, 2010)	Provides direction for the irrigation subsector including measures needed to increase water resources for crop production.	2010
National Forest Policy (1974, 2010)	Guiding policy framework for forest resource management and conservation; it recognizes the role of climate change mitigation and adaptation for long term forest protection, conservation and management.	2010
Forest and Nature Conservation Act, 1995 and Forest and Nature Conservation Rule 2006	Legal framework for protection and sustainable use of forests, wildlife and natural resources including water and soil.	1995 (Act) 2006 (Rules)
Forest fire rules,	Legislative provisions to carry out forest protection using forest fire recontrol and regulation as a tool as per the Forest and Nature Conservation Act.	2012
National Environment Protection Act, 2007	The umbrella legislation that spells out requirements for the protection of all forms of the physical and ecological environment.	2007
Environment Assessment Act, 2000 (Support regulations: Regulations for environmental clearance of projects, regulations for strategic environmental assessment)	It stipulates the requirements for conducting environmental assessments and establishes the procedures for the assessment of potential effects of strategic plans, policies, programs and projects on the environment. It is supported by regulations, sector guidelines, and codes of practice intended to guide its implementation with measures to reduce potential adverse impacts and to promote environmental benefits.	2000
Waste Prevention and Management Act 2009; waste Prevention and Management Regulations 2012	Ensure safe and efficient strategy and action plans on solid waste management.	2009 (Act) 2012 (Regulations)
The Mines and Minerals Management Act, 1995 and The Mines and Minerals Management Regulations ,2002	The act ensures the exploitation of mineral resources in a manner compatible with the social and economic policies of the Government of Bhutan and within the framework of sustainable development, protection of the environment, and preservation of religious and cultural heritage. The regulation sets out procedures to enable implementation of the act including, mining	1995 (Act) 2002 (Regulations)

	operations and management, restoration, monitoring and environmental regulations.	
Disaster Management Act of Bhutan 2013; DM Rules and Regulations 2014		2013 (Act) 2014 (Rules and Regulations)
Biodiversity Act of Bhutan 2003	The Biodiversity Act of Bhutan (2003) provides for the conservation and sustainable use of biological and genetic resources, the equitable sharing of benefits from the use of genetic resources, as well as the transfer of technology and capacity-building at national and local levels on conservation and the use of biological diversity.	2003

5. Implementation

A successful climate change policy or strategy is its conversion from concepts and ideas into action. Implementation of a climate change action plan is dependent on several factors. It is important to consider the activities of the plan and its linkages with the country's existing development policy framework, finances available, political interest, as well as local priorities and incentives.[36] Translating adaptation plans into actions requires the mobilization of substantial financial resources.

The stocktaking assessment is focused on understanding if Bhutan is aware of the availability of funds to finance climate adaptation activities both domestically and internationally, and if it has access to these resources. Secondly, whether it has budgeted funds for adaptation in their national planning, since that is the most crucial indicator of mainstreaming.[37]

For the implementation step in the NAP stocktaking we aim to assess:

- Whether implementation of adaptation projects is linked to priorities identified in the country's official adaptation plan or strategy.
- Whether the country has access to financial resources to cover short-, medium-, and long-term costs for the selected adaptation priorities both from domestic and international sources.
- Finally, whether selected adaptation priorities have been budgeted for in the country's overarching planning and budgeting strategy. (GIZ, SNAP, 2016)

5.1. Existing Implementation Initiatives

At the national level, the 12th FYP promotes Climate Change into the policies and plans for all sectors through its environment, climate change, and poverty integration guidelines for the plan. The National Key Result Areas (NKRA) of the plan on carbon neutral/green and climate resilient development, water and food security, climate proofing infrastructure and disaster risk resilience are some of the sectoral NKRAs identified and expected to be implemented within the plan period.

At the local government level, the local mainstreaming reference group (MRG) has the responsibility to undertake detailed analysis of policy and planning processes to identify windows of opportunity for integrating and mainstreaming climate change and other cross cutting issues. However, local governments face challenges in terms of adequate capacity and financial resources to integrate climate change into local plans, particularly in understanding issues related to climate change impacts, vulnerabilities and adaptation, and climate related disaster risk management.

Bhutan completed its Initial National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) in 2000. It identifies the key climate change concerns for the country and highlighted the fact that Bhutan is one of few countries that has the potential to increase carbon sequestration. These issues were further clarified in the Bhutan's 2006 NAPA.

The Intended Nationally Determined Contributions was prepared through a sector-wide consultative process, that also considered adaptation and identified ten key priorities.

5.1.1. National level Adaptation Strategies

The Strategic Program for Climate Resilience 2017 provides a framework to build the resilience of the climate-vulnerable sectors and at-risk communities across the country. It includes innovative eco-system based

[36] GIZ, 2016, SNAP: Stocktaking for National Adaptation Planning; Assessing Capacity for Implementing NDCs
[37] GIZ, 2016, SNAP: Stocktaking for National Adaptation Planning; Assessing Capacity for Implementing NDCs

approaches to Integrated Flood-Based Management (IFBM) of river basins; Climate-Oriented Watershed Management Plans; Climate SMART Thromde (Township) planning; a robust and innovative Resource Mobilization Strategy, with non-traditional financing options and sustainability mechanisms; climate-resilient CSMIs, and the promotion of adaptation business services; transformational capacity-building approaches; a strong Gender Equity and Social Development (GESI) component; and "Happiness" developmental performance reporting[38].

National Action Plan - Persistence of Biodiversity and Climate Change underpins the current understanding and observations/trends of climate change and biodiversity, possible impacts of climate change at the ecosystem and species level, current gaps and needs and outlines strategies and actions to minimize biodiversity loss and promote sustainable socio-economic development in the country.

Three out of the nine adaptation priority projects were implemented under the NAPA:

- Disaster Management Strategy-Planning for Food Security and Emergency Medicine to Vulnerable Communities;
- Artificial Lowering of Thorthormi Lake;
- Weather Forecasting System to Serve Farmers and Agriculture;
- Landslide Management and Flood Prevention in Critical Areas;
- Flood Protection of Downstream Industrial and Agricultural Areas;
- Rainwater Harvesting;
- GLOF Hazard Zoning (Pilot-scheme for Chamkhar Chu Basin);
- Installation of Early Warning System in Po Chu Basin; and
- Promoting Community-Based Forest Fire Management and Prevention.

The updated NAPA II in 2012 was developed and updated eight priority projects:

- Landslide Management and Flood Prevention;
- Disaster Risk Reduction and Disaster Management Planning Interventions; and providing emergency medical services to vulnerable communities;
- Enhancing National Capacity in Weather Stations and Seasonal Forecasting in Bhutan;
- Application of Climate-Resilient and Environment Friendly Road Construction Nationwide;
- Community-Based Food Security and Climate-Resilience;
- Flood Protection of Downstream Industrial Areas;
- Rainwater Harvesting and Drought Adaptation; and
- Community-Based Forest Fire Management and Prevention.

In 2016, the RGOB endorsed the Intended Nationally Determined Contribution (INDC) and the National Environment Commission submitted it to COP21. The INDC was prepared through a sector-wide consultative process and had identified priorities in both mitigation and adaptation. The RGoB had identified 8 key priorities under mitigation and 9 key priorities under adaptation.

5.1.2. Sector Adaptation Strategies

The RNR Strategies for Adaptation Action, 2016 provides a broad framework for enhancing resilient capacity of the sector to the impacts of climate change. It identified emerging climate change issues in relation to the RNR sector and proposed realistic plan of action preceding the formulation of the 12th FYP with the objective of providing the basis and scope to mainstream climate adaptation into sectoral plans and programs and identify climate change issues, vulnerabilities and adaptation plan of actions.

The Agro-Met Decision Support Systems (ADSS) was designed to generate agromet information products in two dzongkhags of Paro and Punakha-Wangdue valleys, to assist farmers in coping with weather and climate extremes. This includes capacity building to prepare weekly agro-met information and dissemination to

[38] GNHC 2017, Strategic Program for Climate Resilience (SPCR) Under the Pilot Program for Climate Resilience (PPCR)

agriculture extension agents and local institutions; provide timely and efficient farm advisory for better farm management; release the contingency plan for monsoon during NCOF; develop mobile app for Agro-met DSS.

The Climate Services Information System (CSIS) was designed to produce and deliver authoritative climate information data and products at regional and national levels under the NCHM. Its functions will include climate analysis and monitoring, assessment and attribution, prediction (monthly, seasonal, decadal) and projection (centennial scale) as well as tailoring the associated products to meet user needs by customizing the Climate Services Toolkit (CST) and enable NCHM to generate sector-specific climate products and services.

The first volume of *Bhutan's National Forestry Inventory (NFI)* was carried out between 2012 and 2015 focusing only on the traditional forestry parameters related to trees namely (i) forest cover by type, land-use class and dzongkhag; (ii) tree count; (iii) basal area; (iv) growing stock. The report presents updated information on tree resources in the country to serve as a tool for strengthening science-based forest management, governance, and sustainable resource utilization plans and programs.

The second volume of National Forestry Inventory presents the results and estimates on biodiversity, forest biomass, and forest carbon, forest health, forest disturbances, wildlife presence–absence, non-wood forest produce, information on herbs and shrubs. The two volumes combined presents the comprehensive state of forest resources in Bhutan.[39]

The Integrated Water Resources Management Plan establishes a framework and priorities for the implementation of IWRM in Bhutan with the specific objectives of:

- assessing the current situation and prospects of water resources in the light of changing climate formulate the principles and framework within which players in the water sector can plan, implementing and monitoring water resources management in a coordinated manner; and
- proposing priority interventions and tools for integrated water resources management in the country.

The roadmap to modernizing weather, water, and climate services provides an analysis of key hydro meteorological risks and demand for climate services taking stock of the main water-related hazards and climate risks in Bhutan. It identified key sector users of hydromet information, services and products; their needs and priorities, the institutional capabilities; and existing meteorological and hydrological monitoring network, its capacity for weather and flood forecasting, and glacier and GLOF monitoring as key elements of end-to-end early warning systems. The second phase of the roadmap focuses on strengthening disaster related EWS and climate services through basin-level EWS and modernizing agrometeorological services.

The quarterly disease surveillance bulletin of the Royal Center for Disease Control (RCDC) provides updates on diseases surveillance. The following database and information system with SOPs and guidelines for reporting and interventions exist to provide reliable scientific information on health and diseases and ensure informed policies and promote planning of effective and sustainable public health interventions:

- Bhutan Diarrheal Study Information System (BDSIS);
- National, Notifiable Disease Surveillance Information System and Event Reporting Information System (NNDSIS/ERIS);
- Bhutan ILI and SARI information System (ILI-SARI);
- Water Quality Monitoring System (MQMIS); and
- National Early Warning, Alert and Response Surveillance (NEWARSIS).

In addition, there are guidelines and Standard Operating Procedure (SOP) for Acute encephalitis syndrome (AES) surveillance.

[39] MoAF, National Forest Inventory – stocktaking nation's forest resources Vol I & II

5.2. Budgetary Strategies

The 12th FYP has an NKRA on climate change, however, climate change is not fully integrated into the budgetary processes. The Public Environmental Expenditure (PEE) with respect to 'Climate change' is unclear as the RGoB programme, activity and sub-activity budget codes do not capture climate change as a separate theme, except for specific climate change projects assisted by external funding.[40] However, for the year 2011-12, 2012-13, the climate change related expenditures are 13% and 16% of the total PEE in the two fiscal years. [41]

Bhutan developed its first National Adaptation Programme of Action (NAPA) in 2006 with the objective of identifying immediate adaptation activities and integrate climate change risks into the national planning processes. Of the nine projects outlined, Bhutan was able to implement three: artificial Lowering of Thorthomi Glacier Lake, GLOF hazard zoning, installation of Early Warning System on Pho Chu Basin under the LDCF funding window of USD 4.2 million with a co-financing from RGoB at USD 2.6 million. Other funding sources included USD 0.8 million by the Austrian Development Agency, USD 30,000 by WWF and USD 0.526 million by the UNDP.

The NAPA II updated the project profiles in 2012 with emerging climate risks and vulnerabilities (windstorms, cyclones and floods). NAPA 2012 identified eight priority projects with a total GEF/LDC fund of USD 11.49 million to safeguard essential economic and livelihood infrastructure in hazard-prone communities and key industrial areas from increasing climate hazards such as floods, landslides, windstorms and forest fire through reducing vulnerability at high-risk areas and increasing adaptive capacity of community-level disaster risk management institutions.

The ongoing NAPA III focuses on enhancing sustainability and climate resilience of forest and agricultural landscape and community livelihoods. It includes improved climate information systems; managing landslides, floods and forest fires; and enhancing disaster risk management approaches.

The NAPA programmes were the main climate adaptation projects that built climate resilience in small pockets addressing immediate and urgent requirements, a range of projects funded by bi-lateral and multi-lateral development partners on improved climate information systems; managing landslides, floods and forest fires; and enhancing disaster risk management approaches have been implemented (NEC, 2012 National Adaptation Plan process). However, the focus in the past has been mostly on addressing the urgent and immediate threats of climate change and project based.

[40] Public Environmental Expenditure Review of the Royal Government of Bhutan, 2014
[41] Public Environmental Expenditure Review of the Royal Government of Bhutan, 2014

6. Integration

"Integration" or "mainstreaming" climate change means that the paradigm of "Development as usual", has embedded a consideration of climate risks and opportunities. A range of development activities already contribute to reducing vulnerability to climate impacts. But the need to developed taking in long term considerations and in some cases, development measures may instead increase vulnerability to climatic change.

In order to consider climate risks systematically in development planning it is important to integrate climate change considerations into National Development Plans, joint assistance strategies as well as associated programmes and projects in order to enhance climate resilience. Particular attention should also be paid to policies and projects with long-term consequences. In the case of Bhutan, these include large-scale hydropower and other infrastructure projects, major land use planning initiatives, urban development master plans, which are important for achieving economic development and reducing poverty. Climate change adaptation measures will greatly enhance the benefits and sustainability of many development initiatives if they take place at the inception.[42]

The stocktaking exercise for integration/mainstream aims to:

- Identify degree of integration of adaptation issues into the national development strategies/ sectoral strategies and planning process at subnational level
- Identify opportunities and constraints for integrating climate change into planning.
- Build and enhance capacity for integrating climate change into planning.
- Facilitate the integration of climate change adaptation into existing national and subnational planning processes. (GIZ, SNAP, 2016)

6.1. Level of CCA Integration in National Plans

The National Environment Commission (NEC) is the national focal point for climate change in Bhutan. It also acts as the Designated National Authority (DNA) for the Clean Development Mechanism (CDM) of the Kyoto Protocol. Additionally, the GNHC is the focal point for GCF and is also responsible for overall policies and programmes in Bhutan.

A previous exercise conducted by UNEP on "Strategizing Climate Change for Bhutan National Environment Commission Royal Government of Bhutan" in 2009, elaborated the need for Climate Integration. It states that "the NEC does not have a department dedicated to climate change, nor staff assigned on a full-time basis to climate change issues." It was also noting that national visions, strategies, plans and legislation in Bhutan generally make little or no reference to climate change. It concluded on suggesting that Bhutan's Vision 2020 and the "Middle Path" need to be rewritten/revised to make them more sensitive to climate change.[43]

[42] http://www.oecd.org/environment/cc/44887764.pdf
[43] Strategizing Climate Change for Bhutan National Environment Commission Royal Government of Bhutan January 2009 by UNEP

6.1.1. Five Year Development Plans

With the development of National Adaptation Program of Action climate change adaptation was looked across human life and health, agriculture, infrastructure. It also highlighted the need for foreign assistance, not only from the UNFCCC, but also from development partners for adaptation. In parallel a framework to mainstream Environment, Climate and Poverty (ECP) into 11th Year Plan was developed. The ECP framework looked at key ECP pressures/issues within a sector. It also suggested alternative options & opportunities to address the identified ECP pressure (Programme/activities to be mainstreamed into 11th FYP Plan) and linking it with NKRAs & SKRAs.

A major result of ECP and other initiatives is the integration of Gender, Environment, Climate Change, Disaster and Poverty (GECDP) into the 11th FYP. It allowed for integrating these cross-cutting issues at all levels of the government in planning, budgeting and implementation. The GNH policy protocol was also aligned to be conducive to the mainstreaming effort, and in turn the mainstreaming efforts also added value to GNH.[44]

There have been concerted efforts to include GECDP in policies by RGoB. The GNHC has introduced application tools such as environment overview (EO) and Strategic Environment Assessment (SEA) for rapid assessment of policies in the draft stage of development. These tools have mainly served as a basis for responses to respective Ministries if they have effectively integrated GECDP.

6.2. Level of CCA Integration in Sectoral Plans

Policy decisions taken at the sector level affect activities within a sector directly, and indirectly affect other sectors. Sectors in Bhutan that have been identified as important to NAP are infrastructure, energy, agriculture, health, forest, biodiversity and glaciers. However, tourism as a sector is also an important addition that must be considered. Sector wise differentiation is required as certain sectors are particularly sensitive to climate variability and therefore need to factor climate change into sector policy and planning as a matter of priority.

6.2.1. Water Sector

There is no one department under which the Water Sector resides. However, the most key programme is the Water Flagship Programme (2019), it adopts a four-pronged strategic approach to address water issues in Bhutan. The strategies are:

1) Declaration and protection of critical watersheds
2) Development of adequate and climate resilient infrastructure
3) Improvement of drinking water quality surveillance
4) Better implementation of water legislation and governance.[45]

The objective behind climate resilient infrastructure is to take into consideration the future needs of population growth, increasing demands and further the need to have structures designed adequately for decreasing flows in the winter and increased flood risks in the monsoons. This programme will further downscale till the Dzongkhag/Thromde and Gewog level, as they have already been engaged at the inception of the programme.

6.2.2. RNR/ Agriculture Research Policy

The Food and Nutrition Security Policy (2014), aims to secure access to enough food, adequate nutrition for everyone in Bhutan. It helps address some elements of adaptation in the agriculture sector through various policy goals/objectives. Furthermore, the RNR Research Policy (2009) (including agriculture), besides other areas, focusses on mainstreaming environmental changes and impacts including climate change into all aspects of RNR research. The guiding principles in the policy aims that climate change and RNR research and action are to be treated in an inter-dependent manner that balances and synergizes both the GNH pillars and the RNR research process.

[44] Gender, Environment, Climate Change, Disaster and Poverty Mainstreaming in Bhutan report
[45] Water Flagship programme, nd, website

6.2.3. Forest Policy

The National Forest Policy of Bhutan (2009) has integration of climate change, disaster management and new challenges and opportunities in forest governance and management as one of its key features. This policy directs the responsible departments/ ministries to "minimize or reduce impact of climate change on sustainable forest management and development through appropriate adaptation and mitigation measures." It also suggests conducting appropriate research for developing these measures.

6.3. Level of CCA Integration in Local Plans

At the local level the climate change integration would impact the size, aim, focus and method of local plans. At this level policies are translated into projects. Projects need to have climate lens integrated into them as on one hand, they may be vulnerable to the impacts of climate change (e.g. extreme climate events damaging infrastructure). On the other, projects may increase or decrease the vulnerability of natural and human systems to climate change. Both aspects need to be considered at local level planning.[46]

An SEI study (2013) suggests that adaptation has not been integrated into local development plans.[47] In addition to local leaders considering the long-term impacts of climate change in their five-year plans, gewog development plan should incorporate community-based adaptation.[48] The local development plans must conduct vulnerability assessments and mapping exercises to identify and plan for key areas at risk from climate change. Our engagement with stakeholders at Gewog and Dzongkhag level shows that communities and elected leaders are not aware or are less informed on the implications of climate change, their vulnerabilities, adaptive capacities and sensitivities. This is evident from the process of prioritizing planned activities given the limited budget for the local government.

[46] http://www.oecd.org/environment/cc/44887764.pdf
[47] Wangdi, T., P. Lhendup and N. Wangdi 2013. An Analysis of Forestry Policy, Acts and Rules of Bhutan to Mainstream Climate Change Adaptation. Regional Climate Change Adaptation Knowledge Platform for Asia, Partner Report Series No. 13. Stockholm Environment Institute, Bangkok. Available online at: www.weADAPT.org
[48] Wangdi, T., P. Lhendup and N. Wangdi 2013.

7. Participation

An important cross-cutting success factor for NAP that needs to be employed at all stages of the NAP is participation. This could involve participation of all critical stakeholders during the groundwork and addressing gaps, during the preparatory phase, while undertaking implementation strategies, or during the reporting, monitoring and review of the NAP process.[49]

Participation would mean involvement of representatives from government and private entities, as well as civil society, NGOs, and local community groups, including involving women's representatives and other disadvantaged groups. All the vulnerable groups are especially important since they are often disproportionally affected by climate change. This would allow for integrating the perspectives of women and drawing on their unique adaptation knowledge and local coping strategies when formulating the NAP.[50]

The stocktake for participation in the NAP process aims to assess:

- The extent to which relevant stakeholder groups are involved in the national development of strategies
- and planning
- the extent to which representatives of women's organisations and/or other vulnerable groups have participated in the national processes of adaptation planning;
- the extent to which relevant stakeholder groups have been involved in the regional and local planning process of adaptation. (GIZ, SNAP, 2016)

While the 12th FYP actively promotes social accountability and therefore encourages citizen participation in monitoring development plans happening within their community to ensure greater accountability and results, the other adaptation programmes such as NAPA, SPCR and other that are led by development partners always have gender included within their log frame. Most of the climate strategies such as NAPA are guided by "gender equality and women empowerment" objectives. Some of the key Government policies that promote participation are as follows:

7.1. Draft Decentralization Policy/ Vision 2020

In Bhutan 2020: A Vision for Peace, Prosperity, and Happiness, the document sets out the nation's future directions for development and emphasizes a role of decentralization for its development. It can be understood that Bhutan views decentralization as an instrument to reach its economic and social objectives as well as contribute to equitable development.

Decentralization is considered important for improving citizens' participation to enable citizens to actively participate in their local governance affairs and service delivery activities and take responsibility for their own development. The draft decentralization policy also suggests that local leaders "*should be able to ensure that citizens have access to information on services and respond to citizens' needs".*[51]

The key objectives of the Decentralization Policy is "to *enhance the security and sovereignty, preserve and promote cultural heritage sites, promote equitable local development, ensure community participation, develop*

[49] GIZ SNAP, 2016
[50] Technical guidelines for the national adaptation plan process, 2012, UNFCCC, LEG
[51] https://www.gnhc.gov.bt/en/wp-content/uploads/2017/05/Decentralization-Concept-Note-KD2.pdf

division responsibility framework, strengthen inter-agencies coordination mechanism, ensure democratic political stability, and to realize the national goal of Gross National Happiness."[52]

While the policy is still in draft stage it has been integrated in all other policies of the country.

7.2. Gender Equality/ Mainstreaming

As per an ADB's "Bhutan: Gender Equality Diagnostic of Selected Sector" (2014) report, Bhutan, has a better index rate than Nepal, Bangladesh, Pakistan and India although Myanmar has achieved this at a considerably lower per capita gross national income.[53] Sri Lanka and China also have better index rate among the neighbouring countries making them less unequal place for women.

The National Plan of Action for Gender (NPAG) was designed to complement the Tenth Five-Year Plan, The formulation of the NPAG was led by the GNH Commission and the National Commission for Women and Children (NCWC), in consultation with government gender focal points and other stakeholders.[54] The NCWC also manages the Gender Equality Monitoring System (GEMS), which provides reporting guidance to all government Gender focal points.

The proposed Gender Equality Policy aims for a coherent strategic policy framework for the promotion of gender equality in the country. The policy at the operational and programmatic level, aims to provide specific policy directives and guidance to address and mainstream gender concerns in the respective sectoral plans, programs and activities.[55] Additionally, promotion of gender equality and women empowerment is one of the NKRAs of the 12th FYP Plan, aimed at promoting and strengthening women's participation in leadership and the decision-making processes.

7.3. Assessment under UNFCCC Joint Principles for Adaptation

Currently, no climate-resilience references or indicators are contained in the NCWC's Governance Gender Monitoring Handbook, nor by the GNHC.[56] However, disaggregated gender data is being collected in NCWC's GEMS which will be incorporated into the central NKRA system. This will allow for aligning them with climate-resilience and gender indicators. The following table uses the UNFCCC's Joint Principles for Adaptation to assess participation/transparency in the NAP processes in Bhutan.[57]

Table 3: Assessment of level of Participation

Criteria	Status Assessment
Principle A. The formulation, implementation and monitoring of adaptation policies is participatory and inclusive	
Criterion A1. Multiple stakeholders (such as, but not limited to civil society, sub-national governments, research institutes, academia, private sector, and indigenous peoples) participate in defining options and priorities	As mentioned in 12th FYP and other policies, multiple stakeholder participation for defining options and priorities. However, NAP is still at the beginning and CSOs so far haven't been involved.

[52] https://www.gnhc.gov.bt/en/wp-content/uploads/2017/05/Decentralization-Concept-Note-KD2.pdf
[53] Asian Development Bank. (2014)
[54] Asian Development Bank. (2014)
[55] https://www.gnhc.gov.bt/en/wp-content/uploads/2017/05/Gender-Equality-Policy-concept-note_final.pdf
[56] GNHC . (2017) SPCR
[57] https://unfccc.int/sites/default/files/resource/participation%20and%20transparency%20by%20svadapt.pdf

Criterion A2. The knowledge and experience of local communities and indigenous peoples are incorporated	Under NAP implementation strategy, NEC/RGoB encourages the participation of CSOs, knowledge and experiences of local communities. CSOs report have been shared with NECS at workshops, meetings.
Criterion A3. Plans and policies are publicized in ways that local people can understand and engage with	The rural people, particularly those in the remote areas are not aware of this NAP/ of the source of information for CC nor be able to access due to internet connectivity.
Criterion D1. Communities affected by climate change participate in defining adaptation options and priorities	While mentioned in NAP, there has yet to be a clear mechanism for involving communities in the process in the future.
Principle B. Public funds for adaptation are utilized efficiently and managed transparently and with integrity	
Criterion 1. The implementation and financing of plans is periodically monitored by a body on which civil society is represented	National Monitoring and Evaluation System (NMES) with the GNHC serves as a standard system of monitoring and evaluating developmental plans. Most evaluations are conducted under donor funded projects, while there is an Annual Performance Audit to keep track of progress by each sector.
Criterion 2. Adaptation funding is made available through a transparent process of allocation	Allocation of adaptation funding is based on priority needs of each sector deliberated intensely at national scales. The local government engagement is low in the process.
Criterion 3. There is full and free access to information on how adaptation funds are being spent (finances and processes)	External funding allocated and disbursed through the National Budget. Allocations are transparent and made accessible through annual bulletins
Criterion 4. There is a mechanism in place to safeguard against initiatives that might have negative impacts	All projects follow a screening process including environmental and social processes and budget allocation is based on clearances from each compliance division.
Criterion 5. A secure mechanism for expressing grievances and seeking redress is available	Not Known
Criterion G4 Climate information is made accessible to enable adaptive decision making by all stakeholders	Other than climate science data and information by the NCHM, climate information is ad-hoc and lies with the relevant stakeholders who may or may not efficiently communicate with stakeholders.

8. Monitoring and evaluation

An important part of climate adaptation decision-making and the National Adaptation Plan process is Monitoring and Evaluation (M&E). Monitoring and evaluating climate change impacts, financial resources, adaptation results provides valuable information for adaptation planning and decision-making. Decisions regarding climate adaptation must be made amidst multiple future uncertainties (e.g. climatic uncertainties, uncertainties in technological advancements, new thresholds, new adaptive pathways) which makes M&E all the more important.[58] Such systems in place can ensure "effective resource allocation, improve accountability, strengthen the coordination of adaptation plans and activities, and foster learning on adaptation."[59]

Status of an in-country framework for monitoring adaptation will be assessed through:

- the extent to which M&E systems in sector programmes offer entry points to integrate adaptation to climate change
- the extent to which M&E systems exist in the field of adaptation
- the extent to which M&E of adaptation considers gender differences in order to ensure equality between men and women. (GIZ, SNAP, 2016)

M&E can ensure accountability, which is particularly important in the context of climate finance. Especially in case of Bhutan, adaptation M&E can facilitate learning about what does and does not work, and why; as adaptation is still a relatively new policy field. Adaptation M&E helps to answer whether adaptation has taken place, i.e. whether vulnerability has been reduced or adaptive capacity has been strengthened through the NAP process.[60]

8.1. Existing Mechanisms for M&E in Bhutan

Currently in Bhutan, there is no systematic or structured mechanism for collecting information on climate change. Indicators on climate change are developed within existing climate adaptation projects, and present as an overall broad cost-cutting theme in an ad-hoc manner rather than as part of a strategic design.

While, the RGoB measures indicators that are relevant to adaptation, however, the M&E frameworks used are sectoral and do not address any of the challenges specific to adaptation. A review of some of the key programmes and frameworks is as follows:

[58] https://www.nccarf.edu.au/sites/default/files/tool_downloads/Monitoring%20and%20Evaluation%20in%20adaptation%20final.pdf
[59] GIZ SNAP, 2016
[60] https://gc21.giz.de/ibt/var/app/wp342deP/1443/wp-content/uploads/filebase/me/CloserLook_Monitoring_and_Evaluation.pdf

8.2. National Climate Adaptation/ Development Plans

Besides the Climate change policy there are multiple plans and programmes that are key to supporting the implementation of the National Adaptation Plan.

8.2.1. Twelfth Five Year Plan (2018-2023)

The Twelfth Five Year Plan (2018-2023) is a very comprehensive plan that encompasses various elements of adaptation. The NKRAs# 6,17 on Carbon Neutral, Climate and Disaster Resilient Development Enhanced and Sustainable Water are directly related to the National Adaptation Plan.

The targets and result areas described under the 12th FYP have their monitoring and evaluation as per the National Monitoring and Evaluation System (NMES) framework. The GNH Commission through the GNHC Secretariat shall carry out overall monitoring and evaluation of 12th FYP as well as make strategic and timely intervention to provide guidance and direction. Annually, the Government Performance Management Division (GPMD) under the Office of the Prime Minister, is responsible for monitoring the implementation of the plan through the annual performance agreement (APA). It will be carried out as follows:

- Routine annual performance monitoring by GPMD and GNHC through GPMS.
- Monitoring of NKRAs, AKRAs, LGKRAs and KPIs by GNHC.
- Mid-year review of annual performance targets led by GPMD.
- Annual performance evaluation led by GPMD.
- Mid-term review of Plan by GNHC.[61]

Further the responsibilities for leading each NRKA, KPIs have been developed and the Policy and Planning Divisions or equivalent divisions/units within respective agencies are responsible for monitoring sector programmes including liaising with the LGs and other central agencies and provide periodic status update on the plan implementation and KPIs to the GNHC.

8.2.2. Gross National Happiness Commission

The Gross National Happiness Commission Secretariat (GNHC-S) is the nodal agency responsible for planning, coordination, monitoring and mainstreaming of GNH philosophy in national development plans and policies. It is also the National Designated Authority (NDA) for the GCF in Bhutan, and the focal point for the Pilot Programme For Climate Resilience (PPCR).

The GNH evaluation guidelines assess programmes, projects or policies for GNH values besides critical cross-cutting issues such gender, environment, disaster risk reduction, poverty, health and most importantly climate change.62 As per the policy the GHNC-S, as the Guardian of the evaluation policy, shall monitor the implementation of the policy through periodic review and revisions as per the changing needs and systems.[63] However, it important to note that the indicators for CCA are not fully defined in the GNH policy selection tools and lens. These are still very broad and need to be distilled down into each agencies APA.

8.2.3. National Adaptation Program of Action (NAPA) (2006 & 2012)

For NAPA I and II, a Project Working Group (PWG) comprising the eight principal responsible agencies carried out the implementation monitoring activities which reported to the Project Management Unit at NEC through the Annual Project Report (APR) of the UNDP and Project Implementation Review (PIR) as mandated by the GEF. As per the Adaptation Monitoring and Assessment Tool (AMAT) and UNDP M&E frameworks, mid-term evaluation and a terminal evaluation were conducted as per the UNDP Country Office, guided by the UNDP-Environment and Energy Group and UN- Evaluation Group. The Programme Management Unit (PMU)

[61] 12th FYP
[62] Evaluation protocol 2015, RGOB
[63] EVALUATION POLICY OF BHUTAN 2017, RGOB

prepared and submitted the following reports, including facilitating the reviews that formed part of the monitoring process:

- Inception Report
- Project Implementation Review (PIR)
- Periodic Thematic Reports
- Independent Evaluations
- Mid-Term Evaluation

8.2.4. National Disaster Management Act (NDMA) (2013)

Some activities and actions under the NDMA can be constituted as building adaptive capacity. These measures are monitored and evaluated by the Dzongkhag Disaster Management Committee (DDMC) as per the Disaster Management and Contingency Plan. As mentioned in earlier section the current NDMA does not have climate change induced disasters specifically mentioned.

8.3. International NGOs and International Financial Institutions supported Climate Adaptation Programmes

While the key systems for possible M&E of climate adaptation are within the Government bodies, some of the other climate change adaptation related M&E in Bhutan is within the following programmes:

8.3.1. EU: Global Climate Change Alliance –Climate Change Adaptation Programme

For the Climate Change Adaptation Programme (CCAP) (2012-2016) was supported by the European Union (EU), Global Climate Change Alliance (GCCA). It was implemented by the Council for RNR research of Bhutan (CoRRB) Secretariat as a sector budget support programme. The objective of the programme was to:

- Enhance resilience of Bhutan's rural households to the effects of climate change.
- Ensure climate change readiness of the Renewable Natural Resources sector in Bhutan by mainstreaming climate change into the sector and ensuring steps are taken towards increasingly addressing climate change adaptation at multi-sectoral level.[64]
- The activities under CCAP were monitored under the Annual Work- Plan & Budget (AWPB), linked to 11th FYP. The Program Coordination Unit (PCU) housed at the CoRRB Secretariat conducted baseline surveys covering livestock, agriculture and forestry in Kurichu River Basin; while Policy and Planning Division (PPD) looked at developing an RNR- Disaster Preparedness and Response Strategy.
- The AWPBs and progress reports were prepared in standard PLAMS (Planning and Monitoring System) formats and updated on a quarterly basis. It also included monitoring visits to see the actions in the field and document the progress. Finally, the PCU based on stakeholder consultation, site visits and quarterly reports prepared a comprehensive report for MoAF.

[64] Progress Report 2013-2014 for CCAP

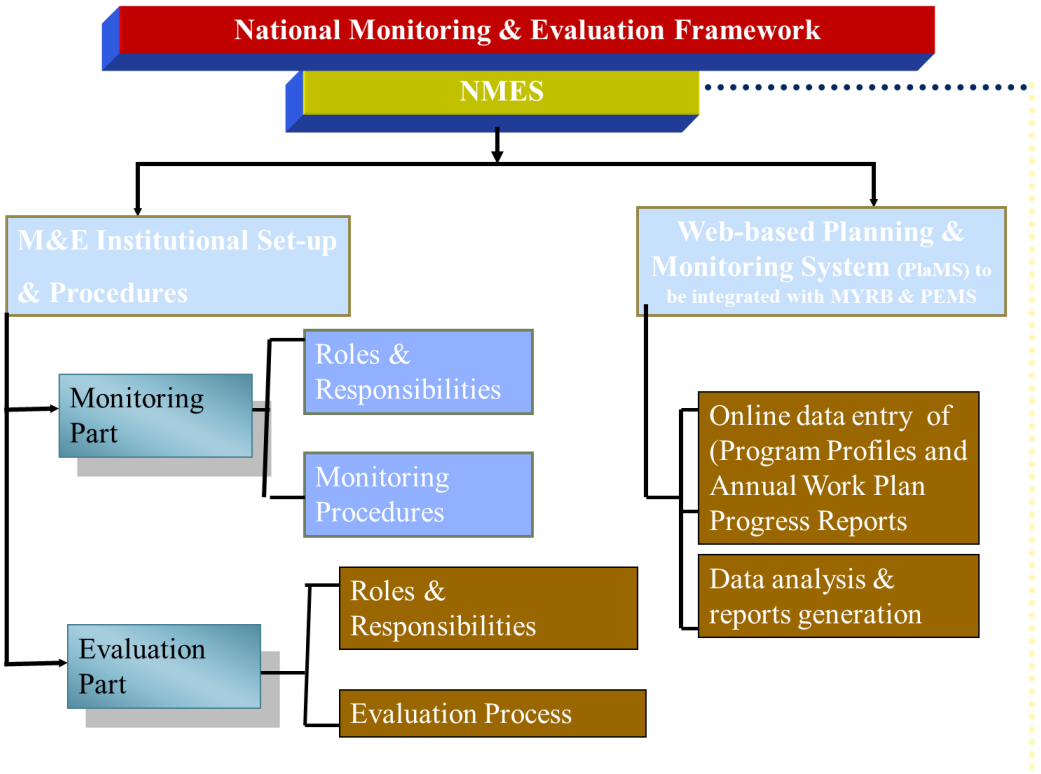

Figure 2: Monitoring and Evaluation arrangement for SPCR

PLAMS (Planning and Monitoring System), is a system under the RGoB's National Monitoring and Evaluation System (NMES) designed and promulgated by GNHC. For the CCAP, the key focus was on the outcomes and impacts, as well as the means of achieving them through outputs, activities, and inputs. The main objective of M&E under CCAP was to bring in efficiency, transparency and evaluate ultimate impacts of the CC projects, where the key players are the departments and Dzongkhags.[65]

8.3.2. Strategic Programme For Climate Resilience Under the Pilot Programme For Climate Resilience

The SPCR is a pilot programme under the Climate Investment Fund (CIF) Pilot Programme For Climate Resilience (PPCR). The 6 key programmes under it are[66]:

- Building Climate Resilience Through Enhancement of Hydro-Meteorological and Cryosphere Information
- Strengthening Climate-Resilient in the Management of targeted Watersheds and Water Sources
- Strengthening Resilience to Flood Hazards
- Supporting Climate-SMART Human Settlement Planning and Development for Samdrup Jongkhar Thromde
- Strengthening Climate Resilience in Private Sector Intervention
- Strengthening Capacity for the Development of a Sound Climate Education Programme in Bhutan

M&E under the SPCR is aligned with the indicators and data as per GNHC's standard NKRA reporting protocols and NEC's proposed Environmental Management Information System (E-MIS). However, as mentioned earlier the SPCR would jointly with the Center for Bhutan Studies, develop indicators to incorporate Climate-Resilience into the 12th FYP NKRA #6: Carbon Neutral, Climate and Disaster Resilient Development Enhanced.

[65] Progress Report 2013-2014 for CCAP
[66] GNHC . (2017) SPCR

SPCR Environmental Management Information System (MIS)

Additionally, the SPCR would support development of an Agency Key Result Area (AKRA) distilling down an NKRA into distinct Agency results corresponding to the constituent Agency that the NKRA covers. SPCR's Program Monitoring and Evaluation System will feed into the M&E system. SPCR Program activities, results and outcomes, will be included in the Annual Performance Agreement of the GNHC and Implementing Partners, and their progress monitored through existing government performance systems. This will allow for SPCR implementing agencies along with their LG and Civil Society partners and stakeholders, to jointly contribute towards their respective NKRA.[67]

The SPCR Environmental Management Information System (MIS) will assimilate disaggregated data on gender equity, climate change food-security, water-availability, and Cottage, Small and Medium Industry (CSMI) integration (e.g. disaggregated data based on age, gender, poverty level, water use, infrastructure risk) besides other climate relevant socio-economic and health indicators.[68]

8.4. Climate Indicators

At present, there is no formalized repository or database for measurement of climate indicators in Bhutan. Indicators on climate adaptation are scattered throughout different departments and remain unconsolidated. The fragmented approach is compounded by the lack of a common platform for climate adaptation and mitigation in Bhutan, making it difficult for key stakeholders to share information.

Following are some of the key impact and adaptation action and result indicators, that are important for Bhutan:

8.4.1. Climate Parameter and Impact Indicators

This list of indicators focusses on two key aspects of climate change[69]:

- Information about observed climatic conditions that help track the climatic context within which adaptation strategies are being implemented
- Observed impacts of climate variability and change on socioecological systems track the climate context within which adaptation strategies are being implemented

Table 4: List of Impact Indicators

Indicator	Status	Responsibility
Climate Risk/ Vulnerability/ Science		
Change in annual temperature	Available	NCHM
Mean monthly temperature	Available	NCHM
Number of hot days	Available	NCHM
Change in annual precipitation	Available	NCHM
Monthly precipitation	Available	NCHM
Extreme precipitation events/ Weather events	Collected Annually	NCHM/ DDM
Agriculture		
Number of households affected by dry spells/ landslide/flash floods	Available	DDM
Percentage of total livestock killed by dry spells/ extreme rainfall	Risks are assessed	DDM
Number of hectares of productive land lost to soil erosion/ flood	No systematic information collection and update	DDM/ DoA, MoAF
Shift of agro-phenological phases of cultivated plants	No systematic information collection and update	DDM/ DOA

[67] GNHC . (2017) SPCR
[68] GNHC . (2017) SPCR
[69] Repository of Adaptation Indicators, IISD & GIZ, 2014

Losses of GDP in percentage per year due to extreme rainfall/ reduced rainfall	No systematic information collection and update	DDM/NSB
Infrastructure		
Number of people living in flood prone areas	Risks are assessed	DDM
Value of property damaged by flood per year	Available	DDM
Number of people permanently displaced from homes as a result of flood, dry spells	Unavailable	DDM
Losses of GDP in percentage per year due to damage on infrastructure attributed to extreme rainfall	No systematic information collection and update	DDM
Financial losses to businesses due to extreme weather events	Only risks are assessed but no data collation	DDM/ DoI/DCSI
Total length of sewerage and drainage network at risk from climate hazards	Only risks are assessed but no data collation	Thromdes/ Dzongkhags/ MoWHS
Number of properties lost due to river bank erosion per year	No systematic information collection and update	DDM/MoWHS
Number of properties located in river floodplain	No systematic information collection and update	DDM, Dzongkhags/ Thromdes/ MoWHS
Hydropower/ Energy		
Weather-related disruption of electricity supply	No systematic information collection and update	DHPS/DGPC
No. of hydropower plants at risk from GLOF	There is no formal data collection and update protocols in place for commissioned hydropower plants. However, risk assessments are carried out.	DHPS
Losses of GDP in percentage per year due to extreme rainfall/ reduced rainfall	No systematic information collection and update	DHPS/DGPC
Losses in hydropower sectors (as a percentage of GDP) per year due to extreme rainfall/ reduced rainfall	No systematic information collection and update	DHPS/DGPC
Forest/Biodiversity		
Total forest area impacted by wildfire per year	There systematic collection of risk information in the last 2 years although there is one assessment on forest fire hazard mapping	DoFPS
Annual timber losses from pests and pathogens	No systematic information collection and update	DoFPS
Percentage of area of ecosystem that has been disturbed or damaged	No systematic information collection and update	DoFPS
Areas covered by vegetation affected by fire/disease	There is no systematic collection of risk information although there is one assessment on forest fire hazard mapping	DoFPS
Distribution of climate sensitive species	No systematic information collection and update	DoFPS
Decline in fish habitats due to temperature change	No systematic information collection and update	DoL/ NCRLF
Health		
Number of people at high risk of dry spells/ extreme cold	No systematic information collection and update	DPH/DDM/NCHM
Number of cases of water-borne diseases	Available	DPH, MOH

Number of cases of vector-borne diseases	Available	DPH, MOH
Number of households within most deprived communities located in areas of flood/riverbank erosion risk	No systematic information collection and update	DDM/MoWHS
Number of hospitals located in areas at risk from flooding/riverbank erosion	Available	DDM/DPH
Tourism		
Losses of GDP in percentage per year due to extreme rainfall/ landslide/ heat	No systematic information collection and update	TCB
Water Resources		
No. of Households with clean drinking water throughout the year/ Population access to safe drinking water (%)	Available	DPH/ Water flagship PMU/ MoH
Number of people permanently displaced from homes as a result of flood, dry spell or other climate events	No systematic information collection and update	DDM, DGM
Number of businesses located in areas of flood/riverbank erosion risk	No systematic information collection and update	DDM/MoEA
Number of surface water areas/ springs subject to declining water quality/quantity due to extreme temperatures	No systematic information collection and update	DPH/ Water flagship PMU/ DoFPS
Glacial Lakes		
Volume of Glacier/ Glacial lake(km3)	Available, need to be updated	NCHM
Basin area	Available, need to be updated	NCHM
Glacier Area	Available, need to be updated	NCHM
Snow cover area	No systematic information collection and update	NCHM

8.4.2. Adaptation Action and Result Indicators

This list of indicators focusses on two key aspects of climate change[70]:

- Information to help track the implementation of adaptation strategies/ development strategies that provide climate co-benefits
- Information to help monitor and evaluate the outcomes of adaptation strategies. These outcomes are broadly understood in terms of increased adaptive capacity, decreased sensitivity etc.

Table 5: List of Adaptation Indicators

Indicator	Status	Responsibility
Disaster Preparedness		
Reduction of flood damage and disaster relief costs in cities due to increased standards for flood protection and improved flood emergency preparedness	No systematic information collection and update	DDM/MoWHS
Percentage of households at reduced flood risk due to construction of new or enhanced defences	No systematic information collection and update	DDM/MoWHS
Priority areas for precautionary flood protection	No systematic information collection and update	MoWHS/DDM

[70] Repository of Adaptation Indicators, IISD & GIZ, 2014

Uptake of early warning systems (UV and air/water quality)	No systematic information collection and update	NECS/ Thromdes and Dzongkhags
Number of businesses with insurance for extreme weather events	No systematic information collection and update	NSB/RICBL/BIL
Agriculture		
Percentage of agricultural land with improved irrigation	Available	DoA
Number of women organised in agricultural cooperatives	No systematic information collection and update	NCWC/DoA
Increase in agricultural productivity through irrigation of harvested land	No systematic information collection and update	DoA
Percentage of cultivated surface cultivated with less water intensive varieties	Available	DoA
Percentage of farmland covered by crop insurance	Available	DoA/ RICBL/BIL
Percentage of livestock insured against death due to extreme and slow-onset weather events	Available	DoL/RICBL/BIL
Turnover generated by agricultural cooperatives	No systematic information collection and update	DoA/DoL
Infrastructure		
Funding for climate-adapted construction and refurbishment	No systematic information collection and update	CDB, CAB, MoWHS
Number of properties with retrofitted flood resilience measures; water meters; water efficiency measures; cooling measures	No systematic information collection and update	Thromdes /Dzongkhags
Green label for neighbourhoods requiring climate change vulnerability assessments established	No systematic information collection and update	DDM/NECS/MoWHS
Percentage of climate resilient roads in the country	Available	DoR
Hydropower/ Energy		
Percentage of new hydroelectric projects that consider future climate risks	Available	DHPS
Number of water efficiency measures used in energy generation/extraction	No systematic information collection and update	DHPS
Forest/Biodiversity		
Area of land under ‘landscape scale’ conservation	Available	FIMS, DoA, DoFPS, MoAF
Number of inventories of climate change impacts on biodiversity	No systematic information collection and update	DoFPS
Uptake of soil conservation measures	No systematic information collection and update	NSSC, DoA/DoFPS
Number of firebreaks constructed	Available	DoFPS
Health		
Percentage of population with access to wastewater treatment plants	No systematic information collection and update	Thromdes/ Dzongkhags
Percentage of poor people in water scarcity-prone areas with access to safe and reliable water	No systematic information collection and update	Water Flagship PMU
Percentage of urban households with access to piped water	No systematic information collection and update	Water Flagship PMU
Percentage of rural households with access to piped water	No systematic information collection and update	Water Flagship PMU

Tourism		
Number of cubic metres of water conserved	No systematic information collection and update	TCB/ HRAB
Volume of water consumed by tourist facilities	No systematic information collection and update	HRAB/TCB/Thromdes
Water Resources		
Number of public awareness campaigns on water efficiency	Available	NECS/Water flagship PMU/Thromdes
Percentage of population living in flood and/or drought-prone areas with access to rainfall forecasts	No systematic information collection and update	NCHM
Percentage of water demand being met by existing supply	No systematic information collection and update	Water Flagship Program, Dzongkhag and Thromdes
Climate Change Education and Awareness		
Percentage of men and women applying flood resistant agricultural practices/ climate change learned in programme-sponsored workshops	No systematic information collection and update	MoIC, Universities
Percentage of men and women aware of climate change science/mitigation/ adaptation	No systematic information collection and update	MoIC
Number of academic programmes offered related to climate change and environmental science both as bachelors and master's level	Information could be obtained from RUB or colleges	RUB
Percentage of students studying award bearing programmes related to climate change and environmental science at both bachelors and postgraduate levels	Information could be collected from RUB	RUB
Number of climate science/adaptation related articles/papers published in peer reviewed international journals	No systematic information collection and update	RUB
Percentage of schools participating in climate change awareness activities for children through project engagement with schools and teachers	No systematic information collection and update	REC

9. Gaps and Barriers for the NAP Process in Bhutan

The process of synthesizing available information and knowledge of climate change in support of the NAP process as a stocktaking would aim to provide an indication of the adequacy of existing data and information, and help identify any major gaps and the resources that may be required to strengthen collection of new data and new analyses.

Taking into consideration the studies and information elaborated in the earlier Sections. This section intends to elaborate on the gaps and barriers in the current scenario. A systematic capacity gap analysis of the national adaptation structures and systems can help develop a strategy or provide inputs to address shortcomings. This will involve the identification of options for strengthening and/or establishing various institutions, bodies, programmes, facilities, policies and legislative frameworks. [71] In addition to the gap analysis, the barrier analysis aims at identifying potential barriers to adaptation planning and to the implementation of adaptation activities, to guide efforts to enhance implementation. [72]

9.1. Gap and Barriers Analysis for Climate Information

For climate adaptation planning, decision makers at the national and local levels require adequate information about the climate change effects, ideally specific to climate vulnerabilities understood as a function of exposures, sensitivity and adaptive capacity. For NAP it is recommended 30-year period from 1960 to1990 to represent a baseline climate, and a projection beyond 1990 to represent a changed climate. But due to lack of time series/ observed data high level resolutions modelling is not possible. Several key sectors depend on NCHM for localized climate information and services to assess and plan for sector-wise adaptation and mitigation. At NCHM, current historical data analysis and projection model is based on downscaled datasets with coarse resolutions that do not adequately resolve Bhutan's small-scale complex topography. This topography is critical as it influences meteorological processes. This leads to high variability in spatial data obtained. The dataset is also a small subset of multiple climate projections available and downscaled data derived by a bias-corrected statistical downscaling method which may underestimate the full range of uncertainties. There is a need for sourcing high-resolution spatial climate model outputs for country specific with near-term and medium term forward-casting impact projection modeling data[73].

Besides there is a clear need for reliable observational network with long term monitoring, that could potentially offset inadequacies of globally available gridded datasets and augment collection of new data given the complex terrains and local influences such as gradients[74].

With the available hydro-meteorological data at the NCHM, much of the output remains beyond the understanding of end-users, and therefore cannot be integrated into policies and plans. There is a need to make climate data accessible to the end users in the formats they can easily understand and incorporate or use (usability), potentially through a one-stop user interface platform that provides a structured means for users or through other modes of communication and sharing of information.

Climate vulnerability and impact assessments of human and natural systems form an important baseline towards adaptation planning and serve as indicators to measure the success of adaptation actions. A few

[71] http://pdf.wri.org/working_papers/ready_or_not.pdf
[72] https://ww2.energy.ca.gov/2011publications/CEC-500-2011-004/CEC-500-2011-004.pdf
[73] GNHC, WorldBank Group: SPCR
[74] NECS 2019

vulnerability and impact studies (often integrated) were carried out by key climate sensitive sectors (forest & agriculture, water, energy). However, most results and outputs are -

- Limited by inadequate climate projection scenarios, representation at finer spatial scales and data coverage for top-down models;
- Limited to community perceptions on vulnerabilities and impacts and expert judgement that do not necessarily quantify the outputs for bottom-up models;
- Scope is limited to adequately represent each sector's vulnerabilities and impacts across geographical regions, gender, age group etc.

Meteorological and surveillance data - Bhutan has very limited meteorological data and sparsely located meteorological stations. There is also limited surveillance for climate-sensitive health outcomes, resulting in insufficient data and lack of awareness of the possible health impacts of climate change across all government sectors including health. The Climate Services Toolkit (2017-2018) identified sector-wise climate data and information gaps and barriers and is summarized as follows:

There is inadequate capacity to analyze hydrological data and making climate information and forecast products relevant to users; GIS and modelling combined with limited meteorological stations resulting in weak database, insufficient lead time for weather forecast and limited representative, localized data; gaps in other parameters of hydrological data (for some river basins) and extreme weather such as storm/ cyclone/ windstorm events; low level of awareness on climate information and channel of dissemination of forecasts.

There is a lack of a common framework with structured approaches and standardized method and tool options appropriate for each component that contribute to climate vulnerabilities. With increasing need to focus on integrating climate change in development approaches, there is a need to look at integrated assessments ideally incorporating sufficient representations, trends, downscaled scenarios at dzongkhag level/local levels.

Table 6: Gap Analysis by Sector

Sector	Gaps	Barriers
Climate science and services	• Lack of observed climate data presents a considerable challenge to improving the quality of downscaled climate scenarios • There is a need to make climate data accessible to the end users in the formats they can easily understand and incorporate or use (usability), possibly through a one-stop user interface platform that provides a structured means for users • Climate impact projections data for multiple end users including the private sector • Limited time scale data for GLOF early warning and rainstorm for Punatsangchu, Mangdechu, and Chamkharchu. • Limited scoping of climate impacts in critical river basin locations and destabilized eco-systems due to limited number of hydromet stations in high risk river basins	• Limited technical capacity on hydromet and cryosphere: agro-meteorology research data management and impact modeling; • Limited capacity to interpret existing data into usable information especially for sector-wise information needs.
Water Resources	• Inadequate climate related hydrology mapping and socio-economic data including vulnerable communities such as farmers and women groups. • Need for comprehensive study of water sources, their historical trends and integrated river basin planning & management for all basins/sub basins	• Weak databases used as the basis for planning models thus resulting in unrealistic and less credible results • Develop criteria to assess, categorize and update comprehensive inventory of

	• Water resource management is uncoordinated • Baseline available for 186 watershed, 7 watershed management plans and 9 watershed plans under process • There is no systematic inventory of wetland and degradation, climate data on wetland vulnerabilities.	remaining glacial lakes and PDGLs. • Inadequate basin level impacts and V&A due to capacity and resource crunch
Infrastructure	• Impact studies of past floods • Preliminary studies on flood risks assessments and hazard zonation maps for 19 dzongkhags • Limited knowledge on climate-SMART land-use planning. • Need for planning guide	• Limited capacity of FEMD to carry out climate related mapping and river basin flood control
Agriculture Sector	• Need for climate indicator (quantifiable) mapping such as loss of landcover, soil erosion and nutrient, water shortages pest and diseases, drought resistant varieties • Localized seasonal forecast; and weather forecast for mid and extended range (10-14 days). • In addition to temperature and rainfall data, other parameters such as wind, solar radiation, soil temperature & moisture are important for the RNR sector • There is inadequate climate change vulnerability assessment for the entire sector	Inadequate capacity to: • analyze hydrological data & forecasts for interpretation. • collect and analyze wind, solar, soil temperature, & moisture etc. • There is resource crunch to undertake assessments for adaptation planning
Forest and Biodiversity	• Baseline data on ecosystem and services, inadequate pest and disease surveillance	• Lack of resources to carry out comprehensive forest and biodiversity vulnerability assessment
Health Sector	• Trends, projections, risk mapping, early warning for natural hazards including events of extremely low temperature	• Low capacity in understanding and translating climate information, impact forecasting, and decision support systems in the health sector
Energy	• Real-time and accurate hydrometeorological data including rainfall, river discharge, suspended sediment • Wind speed and wind direction data Climate data for the development/design of hydropower • schemes	• Insufficient quality checked data and hydrological modeling for energy development including lean and high flow regimes for all river basins.

9.2. Gaps and Barriers Analysis for Long-term Vision and Mandate

There is increasing awareness that policy approach to climate change at the national level do not adequately reflect linkages across sectors and local government levels resulting in duplication of action among agencies. Key barriers to this include a lack of climate change strategy and policy to take on board cross sector issues of relevance.

Bhutan's Vision 2020 and the National Environment Strategy have been the guiding documents for raising the profile of environmental conservation among policy makers and planners in the past decades. In the current development context, emerging issues related to environment and climate change impacts, and institutional and political changes, the policy documents are out of date. At the same time, the legislative documents like the Environment Impact Assessment Act, National Environment Protection Act and the ensuing compliance legal documents do not explicitly consider climate change in its provisions for compliance and regulations. This has been a barrier to integrating climate change into many sectors and local governments plans, but most notably the private sector and state-owned enterprises and their respective scale of investments.

9.3. Gaps and Barriers for Implementation

There is also a communication disconnect between national, dzongkhag, and local levels. Coupled with limited technical capacity and finances, and absence of functional implementation structures across these levels, climate change adaptation and implementation has become constrained. As a result, adaptation measures based on vulnerabilities and capacities assessments are fragmented at best and non-existent mostly at sectoral and local levels. Critical actors for implementation that also provide the financial leverage have existent barriers for full utilization as per the table below:

	Gaps	Barriers
National Government	• Absence of a resource mobilization strategy	• Reduced understanding/ translation of national climate change policy at Gewog level/ Dzongkhag level
Local government	• Low awareness and understanding of climate change impacts and resilience building. • LG are not mandated to prioritize climate change related activities.	• Incoherence in terms of coordination and planning and therefore duplication • Low understanding on cross-cutting issues and therefore planning for the funding mechanism is based on immediate/short term needs. • Most climate change adaptation implementation is project dependent and therefore ad hoc
Private sector/ CSOs/ Others	• No capacity to utilize climate information • No mandate to integrate climate change into policies and plans • No mandate to carry out climate integration into investment policy and projects.	• Large and CSMIs unaware of climate proofing businesses • Most climate change adaptation implementation is project dependent and therefore ad hoc

9.4. Gaps and Barriers for Climate Integration

As we see that climate change adaptation for NAP implementation is integrated in national level plans, sectoral plans in Bhutan. However, there is a need for climate to be integrated into Gewog Development plans.[75] Some of the barriers and gaps for mainstreaming CC at local level are as follows:

	Gaps	Barriers
Political	• Lack of financial resources for translating complex effects of climate change into management actions • Absence of strategic adaptation implementation plan – long term, short term, medium- term.	• Changes in political system and leadership with weak mechanisms for accountability and enforcement of integration
Resources	• Absence of climate finance and aid • A lack of awareness and information about climate risks, opportunities, and trade-offs	• A lack of human capacity to respond to and implement strategies • Technological constraints and uncertainties. • Costs associated with change

9.5. Gaps and Barriers for Participation

Currently, no climate-resilience references or indicators are contained in the NCWC's Governance Gender Monitoring Handbook, nor by the GNHCS.[76] However, disaggregated gender data is being collected in NCWC's GEMS which will be incorporated into the central NKRA system. This will allow for aligning them with climate-resilience and gender indicators.

It is also imperative to use social media and other platforms by the NECS/ UNDP in order to promote public participation in the NAP process, by facilitating feedback, debate and partnership in climate change activities and in governance. There is inadequate understanding of gender dynamics and disproportionate impacts on CC on women and vulnerable groups. There is no information on and use of Indigenous and Traditional Knowledge (ITK) in adaptation programs.

9.6. Gaps and Barriers for Monitoring and Evaluation

M&E for NAP can help ensure that the prospective benefits of interventions aimed at building adaptive capacities and enhancing resilience are being realized and lessons learnt are assisting in the improvement of RGoB's sector plans and programmes. An M&E system in Bhutan needs to have a feedback mechanism which will ensure the continued building of resilience and reduction of vulnerabilities to climate change in the longer term.

Currently climate change is recognized as a crucial issue in virtually all government agencies in Bhutan, however, outcome level/impact level indicators on the same are not explicitly embedded in most of their

[75] Sustainability **2018**, 10, 174; doi:10.3390/su10010174
[76] SPCR proposal to CIF

respective strategic plans. This could be attributed to existing capacity and lack of understanding on climate change adaptation. While there is a national M&E policy, there is a need to include climate change indicators into it. Finally, an institutional arrangement or mechanism for sharing climate change information among the key actors is imperative. Some of the key barriers for M&E of NAP are:

- Long timescales associated with climate change adaptation and indirect impacts from climate-driven socio-economic change;
- Multi-sectoral nature of adaptation, involving many stakeholders/ departments/ agencies and implementation partners; each agency has different requirements for indicators, and their own monitoring and evaluation networks;
- Lack of data on which to base indicator measurements, particularly at a local level, there is a conceptual ambiguity about what constitutes successful adaptation;
- Absence of coordination and harmonization across sectors, scales, and partners;
- Financial, human and technological resource and capacity constraints; and
- While GHNC policy does include climate change as a cross-cutting issue it is difficult to monitor as most existing administrative instruments are designed for single-sector policies. Contributions to a cross-cutting area must be secured by engagement and persuasion of each individual sector.

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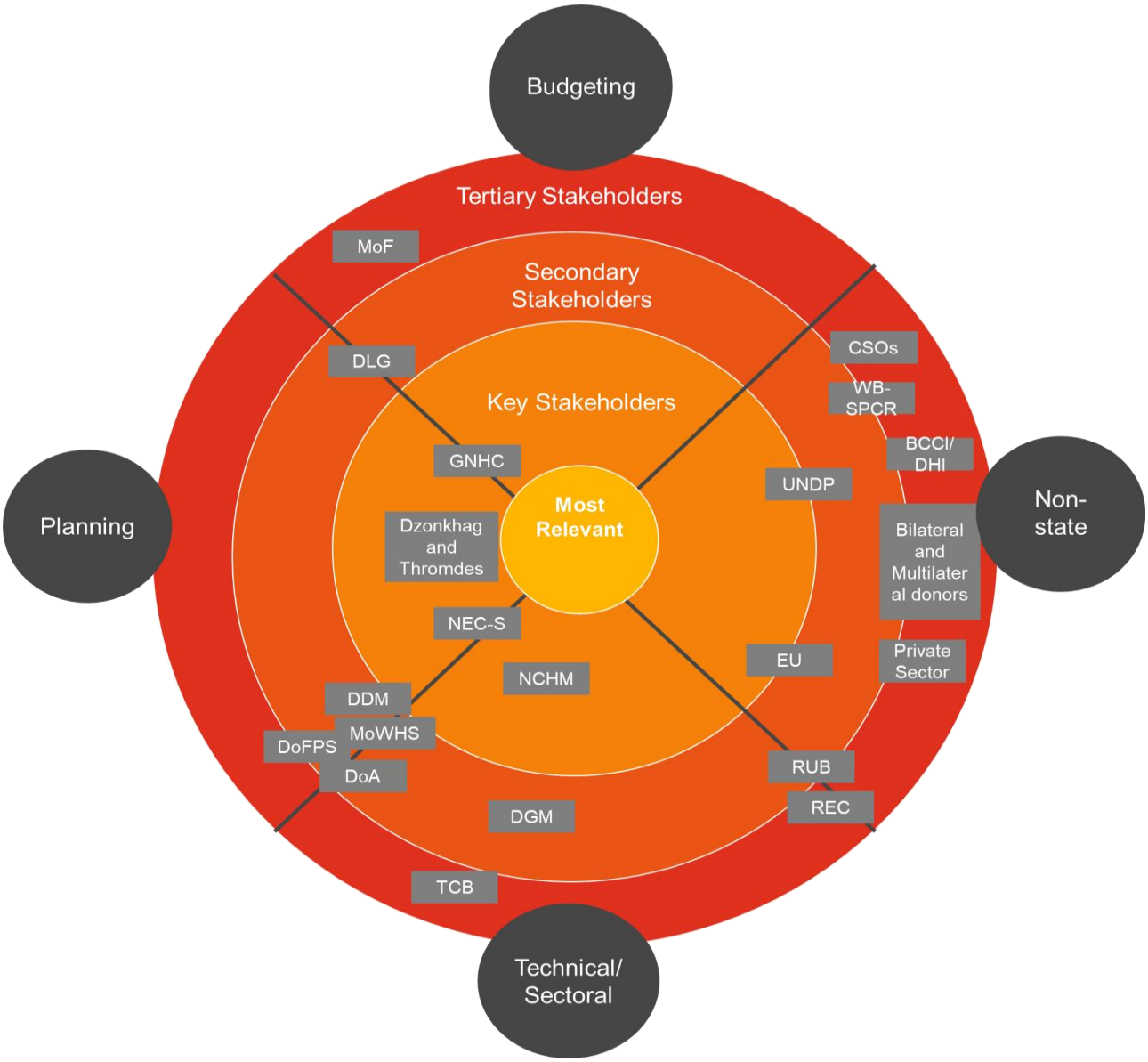
10. Stakeholder Mapping of Entities Relevant for NAP in Bhutan

For an overview of the different actors relevant for the NAP process, the team conducted a stakeholder mapping (see Figure below) with the TWG for the NAP process. The mapping is divided into four types of actors that are highly relevant for a successful NAP process: i) non-state actors; ii) technical actors or actors working in specific sectors; iii) actors responsible for and influencing the overall development planning in the country; and iv) actors relevant for the budgeting in the country.



Further these were mapped as per their relevance to the NAP process, the most relevant stakeholders are the ones that drive the NAP process and are critical to it. The secondary and tertiary stakeholders are support and implement as per the need. There is less understanding among the technical/sectoral actors with regards to NAP process and support required. There is a need for the private sector (including BCCI, DHI) to move from a tertiary role to a more key role in implementing the NAP. The universities could also play a bigger role in the development of research and information required for climate change.

11. Strengths, Weaknesses, Opportunities and Threats

A key component of medium- or long-term planning is the review of internal and external environments, capacities and capabilities. The most popular model for such is the SWOT (strengths, weaknesses, opportunities and threats) model. The model reviews internal strengths and weaknesses, and external opportunities and threats that have an impact on its objectives and goals. The result of a SWOT analysis can be taken as competitive advantage to achieve desired goals and convert current weaknesses into future strengths, as well as minimize impacts that external threats have on its objectives.

Following are some of the key aspects of the SWOT for the NAP process:

11.1. Strengths

This relates to the positive internal aspects of NAP process and emphasizes what is going well with respect to its core functions, operating model and financial performance

Success Factor	Strengths
Climate Information	• Institutions in place with clear mandates and polices and roadmap for obtaining climate information • Recognition of importance of Climate Information at the highest level
Long-term Vision and Mandate	• Policy in place and strong Environmental Legislations in place. (water policy there and climate policy drafted)
Implementation	• The Policy screening tool process involves and takes stock of stakeholder views/concerns • Strong sectoral implementation and capacity
Integration	• Stakeholders/ministries are recognized for climate change • Legislative Impact Assessment should take care of stakeholder concerns during the stakeholder consultations.
Participation	• Strong willingness from stakeholders to participate given opportunity. • Active and strong civil society organization
M&E	• Developed national level M&E system (APAs)

11.2. Weakness

This relates to the limitations and issues within the NAP process that might constitute obstacles to the achievement of objectives

Success Factor	Weaknesses
Climate Information	• Weak coordination among the agencies • Lack of regulatory framework
Long-term Vision and Mandate	• Policy not translated into action in multiple cases due to absence/no understanding of mandate
Implementation	• Lack of common platform for data and climate information • Absence of a long-term financing strategy for climate change
Integration	• Lack of information and data for local development plan • Limited availability/ usability of climate information
Participation	• Lack of coordination and duplication of works among agencies
M&E	• Lack of technical capacities and requisite indicators for measuring climate adaptation actions and impacts in some cases

11.3. Opportunities

This highlights the favorable current or future trends in the external environment. Opportunities represent external factors that the NAP process can take advantage of/capitalize on.

Success Factor	Opportunities
Climate information	• Masters in Renewable Energy (RE), started last year. Interest being generated in studies research on climate science
Long-Term Vision & Mandate	• Political interest in climate change leading to long term vision and mandate including flagship programmes
Implementation	• GCF Agriculture Project, flagship programmes and new environmental strategy/policy can provide chance for developing critical financial re-arrangements
Integration	• Offices of international funding agencies available, need to utilize
Participation	• RAMSAR signatory, many international frameworks have been signed in recent years need to leverage • Strengthening of the decentralization process
M&E	• New Agriculture Decision Support System and other Internet of Things (IOT) being developed for usage

11.4. Threats

This relates to unfavorable trends, barriers, constraints or impending changes in the external environment that can have an adverse impact on the ability to operate efficiently and achieve the goals of the NAP

Success Factor	Opportunities
Climate information	• Absence of a strong focus on climate change- based research
Long-Term Vision & Mandate	• Lack of ownership by relevant stakeholders at different levels • Global Economic Crisis/low ambition has potential to affect climate change funding
Implementation	• Capacity required at all levels. • Lack of follow-up due to low funding to steer NAP processes
Integration	• Sectoral approach to plans • Higher preference for equally important socio-economic and socio-political issues other than climate
Participation	• Empower engagement of local community to take ownership • Non-involvement of private sectors and cooperation.
M&E	• No/less understanding on climate indicators

12. Conclusion and Recommendations for the NAP Process in Bhutan

A consultation was conducted in Paro, Bhutan on 28th November 2019 on validating the findings of the stocktaking and understanding of the gaps and barriers that the NAP process has. This consultation invited stakeholders from government agencies, academia, and Civil Society Organizations (CSOs) that are key to working on climate change.

A group exercise with the stakeholders post the validation session and a scoring was given by the stakeholders based on their understanding of the present situation with regards to the success factors. The scoring was developed as: 0=absent; 1= weak; 2=rather weak;3=neither weak nor strong; 4=rather strong and 5=very strong. After the summation of the scores from the stakeholders, these were then reviewed by the team and finalized as follows (Fig.3):

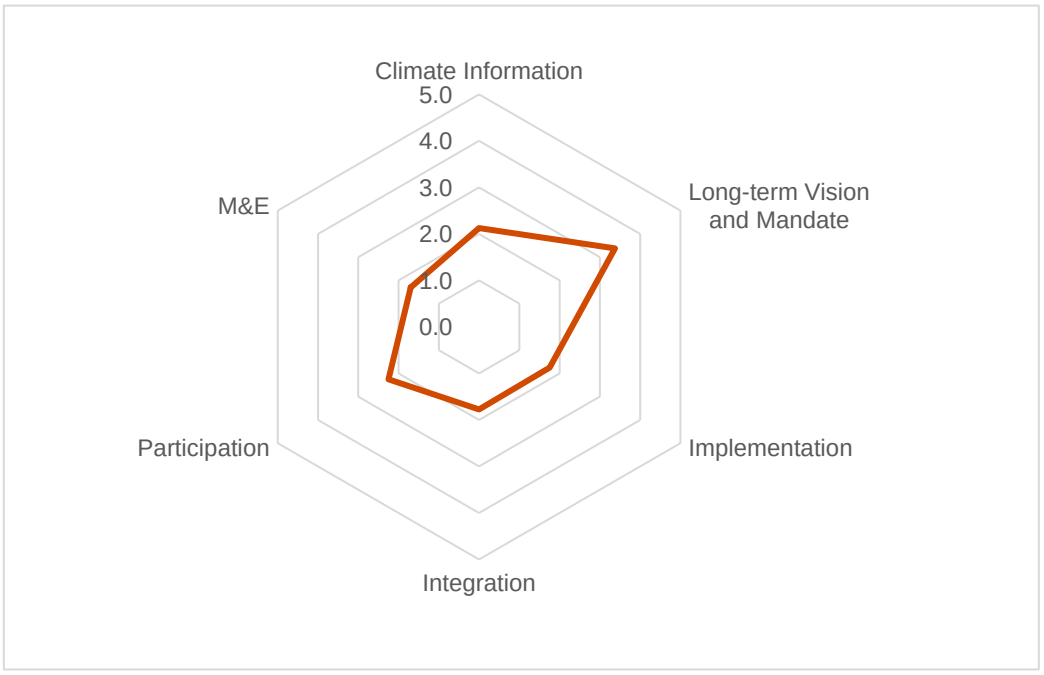


Figure 3: Scoring of success factors

Overall, climate change adaptation is present strongly in the long-term vision and mandate, however the weakest link is the M&E and Integration of climate into local plans.

While the key sectors for NAP are infrastructure, energy, agriculture, health, forest, biodiversity and glaciers; studies have shown that tourism sector can be impacted by climate change through reduced tourist inflow, impact on biodiversity etc. causing reduced sector development.[77] As it a very important sector, due consideration must be given to include climate impact on tourism in Bhutan across all stocktaking success factors.

A long-term goal of this stocktaking exercise should be to arrive at a structured system or database that systematically documents expert knowledge on impacts of climate change in Bhutan in a way that avoids redundant assessments. The compilation of amassed knowledge and data can take various shapes and

[77] http://eu-macs.eu/outputs/tourism-faq/1-how-does-climate-impact-tourism/

formats, such as Internet-based databases that can be accessed and maintained by a variety of users or "state of the knowledge" reports that can be produced at early stages of the NAP.[78] Some of the other key recommendations to strengthen the success factors for stocktaking are as follows:

12.1. Climate information

The key gaps and weakness that were analysed for climate information was absence of information and knowledge sharing between stakeholders, this was also exacerbated by weak coordination among the agencies. While there is lack of observed climate data and detailed resolutions of climate projection, a more critical gap is a lack of vulnerability studies of the priority sectors and community livelihoods. Some of the key recommendations in that regard is as follows:

12.1.1. Compiling and Sharing Existing Information on Vulnerability and Adaptation Options

With sectoral approaches to climate change assessments and adaptation plans, there is a need to develop a comprehensive compendium of existing information on vulnerability and adaptation options primarily as an input into decision-making, and contribute towards the broader iterative cycle of planning, designing, managing, implementing, and evaluating climate-resilient development actions across sectors. At the national level, this may be useful for identification and analysis of adaptation options and determine the extent of climate proofing policies and strategies such as the NES and Vision 2020 updates.

Next Steps:

- Commission a compilation of existing assessments in consultation with relevant stakeholders
- Validate information
- Publish and share document with all stakeholders for use in policy and planning

12.1.2. Development of a repository/ database of climate information

In addition to improving climate models, observation system, and analytical tools, to generate climate services for various user, there is an increasing need to call for a single platform to develop a repository of climate database and information that is both accessible and usable by all. It may be a single entity or involve mobilizing sectors to build dedicated data centers, support sharing of relevant and historical weather records, and to support user-friendly and open-source platforms.

Next Steps:

- Compile all database systems available with different sectors such as NCHM, DDM, MOAF, MOWHS, NECS.
- Develop appropriate platform to integrate and consolidate available information
- Identify roles and responsibilities of each climate data information users and service providers

12.1.3. Completing Vulnerability and Risk Analysis

There is an impending need to commission climate risk and vulnerability assessments to complete the risk analysis phase, identify and prioritize sectors and regions for immediate actions to address the effects of climate change and build resilience of vulnerable populations and sectors. Various tools are available and sector and scale specific tools may be used based on the contextual needs. Especially for sectors that have never been applied a climate lens such as Tourism.

Next Steps:

- Securing funding to conduct the planned vulnerability and risk analyses.
- Expanding the database and information platform mentioned above to incorporate this additional information.

[78] NAP Technical Guidelines, 2012

- Gathering the data and conducting the analyses.
- Bringing key stakeholders together to reflect on the analyses and make recommendations for the NAP process.

12.2. Long term vision and mandate

There is an expressed need to formulate a long-term strategy to address vulnerability to climate change at the national, local and sectoral levels. The strategy should provide a holistic framework with overall objectives of enhancing resilience, reducing vulnerability as well as increasing sustainability. Bhutan has also made commitments to various global conventions and declarations, including UNFCCC, Paris Agreement, Sendai Framework and other international agreements. The strategy will enable the country to address the provisions under the global and regional commitments. Such a strategy will also help development partners identify and mobilize resources to support mitigation and adaptation strategies in their areas of interest.

Bhutan's Vision 2020 and the "Middle Path" along with the development philosophy of "Gross National Happiness" have been vital instruments for raising the profile of environmental conservation among policy makers and the general public. However, there is an urgent need to rewrite/revise these documents to make them more sensitive to climate change[79].

Next Steps:

- Upscale the recently prepared climate change policy to guide climate change mainstreaming and integration into development planning and implementation by all stakeholders at local, district and national levels, including the private sector.
- Develop an enabling framework for a pragmatic, coordinated and harmonized approach to climate change management and provide strategic direction for Bhutan's priorities for climate change interventions
- Push for a more robust institutional framework for implementation of adaptation, mitigation, technology transfer and capacity building measures.

12.3. Implementation

12.3.1. Developing a Resource Mobilization Strategy

Apart from three National Adaption Program of Action and other multi-lateral financing for climate change adaptation, inadequate financial resources and capacity have showed up as the two major challenges to effectively plan and implement long-term adaptation at the national, local and sectoral levels. There is an expressed need to develop a financing strategy to ensure that climate finance can be effectively accessed, mobilized and scaled up to contribute to achieving the climate goals. At the same time, the strategy should make the scaling up of climate finance predictable and clear and to provide opportunities for attracting climate-friendly investment in the priority sectors and strengthen institutional capacity to implement climate actions.

Next steps:

- Identify priority climate projects and link them to appropriate financing instruments
- Prioritize adaptation projects identified
- Developing an initial cost estimate for NAP implementation (to be refined once the NAP is finalized).
- Identifying existing sources of funding for implementing adaptation actions, and potential gaps.
- Develop multi-sectoral project pipelines for mitigation and adaptation priorities
- Develop appropriate and innovative financing instruments

[79] NEC 2009, Strategizing Climate Change for Bhutan

12.4. Integration

12.4.1. Developing a NAP Framework

There is an absence of strategic adaptation implementation plan that is integrated in the long term, short term, medium- term level developmental planning. This is compounded by the lack of awareness and information about climate risks, opportunities, and trade-offs at multiple levels (national and local). Further limited availability/ usability of climate information Sectoral approach to plans. Development of a NAP framework that describes the overarching elements and strategic priorities of the process could help to maintain the momentum gained during the stocktaking. The adaptation pathways that have already been identified TNA provide a strong foundation for a NAP framework. A framework may give direction for such a strategic adaptation plan.

This could be further developed to describe the enabling elements, including institutional arrangements, roles and responsibilities of different actors and strategies for capacity development.

Next steps:

- Developing a Terms of Reference for the Framework.
- Assigning responsibility for its development.
- Consulting with key stakeholders once a draft is produced.
- Finalizing, publishing and disseminating the framework document.

12.5. Participation

A key gap and weakness in the participation success factors was Lack of coordination and duplication of works among agencies, non/less-involvement of private sector, universities in adaptation action. This is also seen at the local level where due to less engagement there is no ownership of communities for adaptation intervention. Similar is the case of local governments.

12.5.1. Expanding Stakeholder Engagement Mechanisms

For meaningful and effective integration of climate change into local development practices, a broad and sustained engagement of local stakeholders needs to evolve through processes that ideally recognize major barriers: including information sharing by raising awareness on climate change impacts on investment portfolios; access to financing and financial instruments; and developing legal and policy frameworks for private sector and local government engagement.

At the same time, there are opportunities to integrate CC into (i) local development plans through a process that has an accountability mechanism built into the plans, and (ii) engaging private and civil society organizations for local level climate actions. The Tarayana Foundation's water harvesting projects and Haa valley's community-based tourism have led to effectively lead climate change actions and integration into projects and programs.

12.5.2. Engaging Central and Local Governments in The NAP Process

With the new decentralization policy becoming a reality, engaging the Dzongkhag and Gewog local governments in the NAP process is a key priority. Gewog representatives should also have a voice in the planning process at the national level, perhaps through a committee that feeds into the discussions in the NAP sectoral working groups. This entity could also take responsibility for sharing information on the national process with colleagues and sub-national governments in their respective jurisdictions.

This will help to build ownership and ensure that the NAP reflects local realities. However, an investment in capacity development is required for Dzongkhag and Gewog local government officials to meaningfully engage with the NAP process.

Next steps:

- Clarifying the roles and responsibilities of the central and local governments in the NAP formulation phase.
- Establishing a mechanism for central representatives to feed into the national NAP discussions and share information at sub-national levels.
- Establishing mechanisms for cross-sectoral coordination at central level.
- Identifying urgent adaptation capacity development needs for central and local governments to engage in the NAP process.

12.6. Monitoring and Evaluation

The key gap for M&E is the absence of coordination and harmonization across sectors, scales, and partners for climate adaptation monitoring. Further these is no/less understanding on climate indicators across departments. It is compounded by the lack of technical capacities and requisite indicators for measuring climate adaptation actions and impacts.

12.6.1. Institutional framework for Adaptation M&E

As mentioned earlier the data for climate adaptation is not organized in Bhutan. A mechanism is necessary amongst all stakeholders for collecting climate adaptation information, assimilating and analyzing it in order to measure whether adaptation is taking place. Following are the suggested roles of key players in an adaptation M&E system at National/ Dzongkhag level in Bhutan:

Institution/ Body	Role in adaptation M&E
Government Performance Management Division (GPMD) in the GHNC	• Overseeing development of outcome-based/ national adaptation indicators for the ministries • Target setting and evaluation of performance against targets for outcome-based/ national adaptation indicators • Publication of climate related national performance indicators
NECS	• Coordination of adaptation and other M&E activities • Assimilating and analyzing information from data collected from Ministries • Ownership of relevant outcome-based/ national adaptation indicators • Collection of data required from the ministry and measurement of outcome-based/ national adaptation indicators
NAP Monitoring and Evaluation Nodal Point [one per ministry/ sector]	• Coordination, preparation and submission of M&E reports from the sector containing all new adaptation indicators owned by the ministry
Climate Change Coordination Committee (CCCC)	• Approval of NAP national performance indicators
Dzongkhag Government/ Departments	• Coordination of Dzongkhag level adaptation and other M&E activities • Overseeing development of outcome-based adaptation indicators for the Dzongkhag-level departments • Target setting and evaluation of performance against targets for outcome-based adaptation indicators • Collection of data required across the Dzongkhag and measurement of outcome-based adaptation indicators • Target setting and evaluation of performance against targets for process-based adaptation indicators

These roles are yet to be agreed upon as most of the arrangements being proposed in this recommendation do not exist. Capacity requirements for adaptation M&E will also be important and the Skills assessment report gives details on how these will be achieved.

12. Bibliography

ADB and NECS. (2016). Water- Securing Bhutan's Future; Asian Development Bank and National Environment Commission. Bhutan: Sourced at https://www.think-asia.org/handle/11540/7507.

ADB. (2014-2018). Climate change country risk assessment.

Asian Development Bank. (2014). *Bhutan;gender equality diagnostic of selected sectors*. Oakland: O Books Sun & Moon.

Bahadur, A. V. (2010). Workshop Report: The Second International Workshop on Mainstreaming Adaptation to Climate Change – Managing Adaptation Processes [online]. New Delhi: AdaptationCommunity.net, p. 34.

Below, T., Bünner, N., Jogesh, A., Steeves, J., Coudel, N. and Firth, J. (2016). SNAP: Stocktaking for National Adaptation Planning. Eschborn: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

Berry, P., Enright, P., Shumake-Guillemot, J., Villalobos Prats, E. and Campbell-Lendrum, D. (2018). Assessing Health Vulnerabilities and Adaptation to Climate Change: A Review of International Progress. International Journal of Environmental Research and Public Health, 15(12), p.2626.

Bhutan Climate + Change Handbook (2016), Thimphu, Bhutan: Bhutan Media and Communications Institute. - 130. P

Chhogyel, N., & Kumar, L. (2018). Climate change and potential impacts on agriculture in Bhutan: a discussion of pertinent issues. Agriculture & Food Security, 7(1).

DDM, (1996), Glaciers and Glacier Lakes in the Headwaters of Major River Basins of Bhutan

DDM. (2015). Disaster Risk Management Status Review; Towards identifying national and local priorities for the implementation of the Sendai Framework for Disaster Risk Reduction. DDM, Ministry of Home and Cultural Affairs.

DoFPS. (2011). National Forest Inventory. Department of Forest and Park Services, Royal Government of Bhutan.

DoFPS. (2011). National Forest Policy . Department of Forest and Park Services, Royal Government of Bhutan.

GEF (2020). *A path to the modern economy: Using traditional knowledge to build livelihoods and preserve nature in Bhutan*. [online] Global Environment Facility. Available at: https://www.thegef.org/news/path-modern-economy-using-traditional-knowledge-build-livelihoods-and-preserve-nature-bhutan [Accessed 13 Feb. 2020].

GIZ, 2014, Repository of Adaptation Indicators, IISD & GIZ, 2014

GNHC (2014). *Food and Nutrition Security Policy of the Kingdom of Bhutan*. Royal Government of Bhutan.

GNHC . (2017). Strategic Program for Climate Resilience under the Pilot Program for Climate Resilience. Climate-Resilient and Low-Carbon Sustainable Development Toward Maximizing the Royal Government of Bhutan's Gross National Hapiness. Gross National Happiness Commission, RGoB.

GNHC, Decentralization-Concept-Note , https://www.gnhc.gov.bt/en/wp-content/uploads/2017/05/Decentralization-Concept-Note-KD2.pdf

GNHC, Gender-Equality-Policy-concept note, https://www.gnhc.gov.bt/en/wp-content/uploads/2017/05/Gender-Equality-Policy-concept-note_final.pdf

GNHC. (2011). Bhutan National Development Report 2011, Sustaining Progress: Rising to the Climate Challenge. UNDP, GNHC.

GNHCS, MOEF (2014) Public Environmental Expenditure Review of the Royal Government of Bhutan

Hammill, A. and Price-Kelly, H. (2020). *NDCs, NAPs and the SDGs to Advance Climate-Resilient Development*. [online] Ndcpartnership.org. Available at: http://ndcpartnership.org/using-ndcs-naps-and-sdgs-advance-climate-resilient-development [Accessed 13 Feb. 2020].

Häusler, H.; Leber, D.; Schreilechner, M.; Morawetz, R.; Lentz, H.; Skuk, St.; Meyer, M.; Janda, Ch.; Burgschwaiger, E. (2000) Final Report of Raphstreng Tsho Outburt Flood Mitigatory Project (Lunana; Northwestern Bhutan): Phase II. Vienna, Austria: Institute of Geology, University of Vienna

IPCC (2014). Summary for policymakers. In: Field, C. B., V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P. R. Mastrandrea, and L. L. White (eds.). Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom, and New York, NY: Cambridge University Press, pp. 1-32.

Lonsdale, W., Kretser, H., Chetkiewicz, C. and Cross, M. (2017). Similarities and Differences in Barriers and Opportunities Affecting Climate Change Adaptation Action in Four North American Landscapes. *Environmental Management*, 60(6), pp.1076-1089.

Mahagaonkar, A., Wangchuk, S., Ramanathan, A., Tshering, D. and Mahanta, C. (2017). Glacier Environment and Climate Change in Bhutan—An Overview. Journal of Climate Change, 3(2), pp.1-10.
Mahagaonkar, A., Wangchuk, S., Ramanathan, A., Tshering, D. and Mahanta, C. (2017). Glacier Environment and Climate Change in Bhutan—An Overview. *Journal of Climate Change*, 3(2), pp.1-10.
Ministry of Agriculture and Forests (2010). *Bhutan Land Cover Assessment 2010*. Technical Report. Thimphu: Royal Government of Bhutan.
MoAF. (2016). State of Climate Change Report for the RNR Sector. RNR Climate Change Adaptation Program. Thimphu: Ministry of Agriculture and Forest, RGoB.
National Environment Commission (2018). *Climate Change Policy of the Kingdom of Bhutan*. Royal Government of Bhutan.
National Environment Commission (NECS). (2000). Environmental Assessment Act. National Environment Commission Secretariat, Royal Government of Bhutan.
National Environment Commission (NECS). (2007). National Environment Protection Act. National Environment Commission Secretariat, Royal Government of Bhutan.
National Environment Commission (NECS). (2012). National Strategy and Action Plan for Low Carbon Development. Thimphu: Bhutan: National Environment Commission .
National Environment Commission (NECS). (2016) Bhutan Water Risk Scenarios and Opportunities for Resilient Development).
National Environment Commission (NECS). (2016). a; Climate Change Modelling and Assessment, ADB CDTA 8623Change through Integrated Water Resources Management. Asian Development Bank-National Environment Commission.
National Environment Commission (NECS). (2016). Bhutan Drinking Water Quality Standard.
National Environment Commission (NECS). (2016). National Integrated Water Resources Management Plan. ADB CDTA 8623 BHU: Adapting to Climate Change through Integrated Water Resources Management, Asian Development Bank.
National Environment Commission (NECS).(2019); Third National Communication Vulnerability And Adaptation Assessment**,** Royal Government of Bhutan.
National Environment Commission (NECS).. (1998). National Environment Strategy. National Environment Commission Secretariat, Royal Government of Bhutan.
National Environment Commission (NECS).. (2007). Bhutan Water Policy. Thimphu: Royal Government of Bhutan.
National Environment Commission (NECS).. (2013). Brief Report on Air quality status 2011-12. Climate change division, NECS.
National Environment Commission (NECS).. (2014). The Water Regulation of Bhutan 2014 . Thimphu: Royal Government of Bhutan.
National Environment Commission (NECS).. (2016). b; Hydrological Modelling and Water Resource Assessment of Bhutan, ADB CDTA 8623 BHU: Adapting to Climate Change through Integrated Water Resources Management. Asian Development Bank – National Environment Commission.
National Environment Commission (NECS).. (2016). Bhutan Water Risk Scenarios and opportunities for Resilient Development . National Environment Commission.
National Environment Commission (NECS).. (2016). Wangchhu Basin Management Plan. National Environment Commission.
National Environment Commission (NECS).. (2017). Draft Climate Change Policy. National Environment Commission Secretariat, Royal Government of Bhutan.
NCHM. (2018). Climate Data Book of Bhutan, National Centre for Hydrology and Meteorology. Thimphu: Royal Government of Bhutan.
NCHM. (2019). Analysis of Historical Climate and Climate Projection for Bhutan. Thimphu: National Centre for Hydrology and Meteorology, Royal Government of Bhutan.
NTGMP 2018, MOEA, https://www.moea.gov.bt/wp-content/uploads/2018/11/National-Transmission-Grid-Master-Plan-2018.pdf
OECD (2009). Integrating climate change into development co-operation. Paris: Organisation for Economic Co-operation and Development (OECD).
Parker L. et. al. 2017. Climate change impacts in Bhutan: challenges and opportunities for the agricultural sector. Working Paper No. 191. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)
Pilato, G., Sallu, S. and Gaworek-Michalczenia, M. (2018). Assessing the Integration of Climate Change and Development Strategies at Local Levels: Insights from Muheza District, Tanzania. Sustainability, 10(2), p.174.
Pillai, Poonam; Tshering, Dechen; Abawi, Yahya; Wang, Sonam. 2016. Strengthening Agro-Met Services in Bhutan (English). Washington, D.C. : World Bank Group.

http://documents.worldbank.org/curated/en/367871546582390434/Strengthening-Agro-Met-Services-in-Bhutan
Sustainabledevelopment.un.org. (2019). *Synergies between the 2030 Agenda and Paris Agreement: An Overview*. [online] Available at: https://sustainabledevelopment.un.org/content/documents/22152Background_Paper_WRI_SDGNDC_Synergies_draft_25.03.28_1_.pdf [Accessed 13 Feb. 2020].
UNDP (2017). *Aligning Nationally Determined Contributions And Sustainable Development Goals: Lessons Learned and Practical Guidance*.'
UNDP, UNEP, GEF, (2015), Applying Climate Information for Adaptation Decision-Making
UNFCCC (2012). Technical guidelines for the national adaptation plan process. Bonn, Germany: United Nations Climate Change Secretariat.
UNFCCC, Least Developed Country Expert Group (2012). National Adaptation Plans: Technical Guidelines for the National Adaptation Plan Process[online]. Bonn: UNFCCC, p. 148.
Wangdi, T., P. Lhendup and N. Wangdi 2013. An Analysis of Forestry Policy, Acts and Rules of Bhutan to Mainstream Climate Change Adaptation. Regional Climate Change Adaptation Knowledge Platform for Asia, Partner Report Series No. 13. Stockholm Environment Institute, Bangkok. Available online at: www.weADAPT.org
World Bank (2016). Strengthening Agro-Met Services in Bhutan. Royal Government of Bhutan.

13.Annexures

14.1. List of Resources Helpful for Bhutan's NAP Process

Title	Year	Link
11th Five Year Plan (FYP), Vol I, Main Document	2013-18	https://www.gnhc.gov.bt/en/
12th Five Year Plan (FYP)	2018-23	https://www.gnhc.gov.bt/en/
Adapting to Climate Change through IWRM (Completion Report)	2018	https://www.adb.org/projects/documents/bhu-46463-002-dpta
Analysis of Historical Climate and Climate Change Projection	2019	http://www.nchm.gov.bt/home/pageMenu/32
Annual Health Bulletin & Annual Health Reports	Various	http://www.health.gov.bt/wp-content/uploads/moh-files/2017/06/AHB_2019.pdf
Agricultural Diversification and Rural Incomes in the Presence of Climate Change in Central-Western Bhutan	2019	http://www.bjnrd.org/uploads/pdf/1575299922.pdf
Assessment of capacities and needs of providers (national center for hydrology and meteorology) and users (agriculture sector) for climate services	2017	http://www.nchm.gov.bt/home/pageMenu/32
Assessment of Climate Change Vulnerabilities In Kangpara Gewog, Trashigang	2012	http://www.rspnbhutan.org/
Bhutan 2020: A Vision for Peace, Prosperity & Happiness, Planning Commission (Parts I & II)	1999	https://rtm.gnhc.gov.bt/wp-content/uploads/2019/01/Bhutan2020_vol2-1.pdf
Bhutan Disaster Risk Management Status Review	2016	http://www.ddm.gov.bt/downloads
Bhutan Gender Equality Diagnostic of Selected Sectors	2014	https://www.adb.org/sites/default/files/institutional-document/149350/gender-equality-diagnostic-bhutan.pdf
Bhutan glacier Inventory	2018	http://www.nchm.gov.bt/home/pageMenu/32
Bhutan Living Standard Survey	Various	http://www.nsb.gov.bt/main/main.php#&slider1=4
Bhutan State of the Climate	2017	http://www.nchm.gov.bt/home/pageMenu/32
Bhutan Vulnerability baseline Assessment	2016	https://www.gnhc.gov.bt/en/wp-content/uploads/2017/11/UNDP-Book-for-Website.pdf
Bhutan Wangchu Basin Management Plan	2017	https://www.adb.org/projects/documents/bhu-46463-002-dpta
Bhutan –Water Risk Scenarios & Opportunities for Resilient Development, Insights from a Participatory Scenario Building Process	2015	http://d2ouvy59p0dg6k.cloudfront.net/downloads/bhutan_water_risk_scenarios_and_opportunities_for_a_resilient_development_report_vol_1___2.pdf
Climate change impacts on the flow regimes of rivers in Bhutan and possible consequences for hydropower development		http://www.nchm.gov.bt/home/pageMenu/32

Climate Change Vulnerability Assessment and Adaptation Planning Report	2016	https://info.undp.org/docs/pdc/Documents/BTN/Annex%2014%20-%20Climate%20Change%20Vulnerability%20and%20Adaptation%20Planning%20Report[1].pdf
Climate Change Vulnerability Assessment of Wangchuck Centennial Park	2011	http://www.wwfbhutan.org.bt/?201392/
Climate Data Book of Bhutan	2018	http://www.nchm.gov.bt/home/pageMenu/32
Developing Capacitates for Effective Climate Services in Bhutan (Climate Services Toolkit)	2017-1028	http://www.nchm.gov.bt/home/pageMenu/32
Draft Strategic Program for Climate Resilience (SPCR) documents for comments	2017	https://www.gnhc.gov.bt/en/?page_id=45
Economic development Policy	2016	https://www.moea.gov.bt/wp-content/uploads/2017/07/Economic-Development-Policy-2016.pdf
Elephant Conservation Action Plan for Bhutan	2018	http://www.dofps.gov.bt/?page_id=116
Environmental and Social Management Framework, PPCR, Submitted to the World Bank	2016	http://www.moaf.gov.bt/moaf-reports/
Extreme Weather Events in Bhutan	2018	http://www.nchm.gov.bt/home/pageMenu/32
Flood Assessment Report	Various	https://www.mowhs.gov.bt/en/publications/des-2/femd/
Forest Resource Management in the Context of Climate Change Adaptation and Mitigation in Bhutan	2016	http://www.bjnrd.org/uploads/pdf/1482223813.pdf
Forest Facts and Figures	2018	http://www.dofps.gov.bt/wp-content/uploads/2016/03/FFF-2018.pdf
Forest Resource Potential Assessment of Bhutan	2013	http://www.dofps.gov.bt/?page_id=116
Inventory of glaciers, glacial lakes and glacial lake outburst floods, Bhutan	2001	http://www.nchm.gov.bt/home/pageMenu/32
Journal of RNR Bhutan	Various	http://www.moaf.gov.bt/moaf-reports/
Kingdom of Bhutan Intended Nationally Determined Contribution (INDC)	2017	https://www.gnhc.gov.bt/en/?page_id=3424
Kingdom of Bhutan, Second National Communication to the UNFCCC	2011	https://www.gnhc.gov.bt/en/?page_id=3424
Land Use Land Cover (Maps & Statistics)	2016	http://www.dofps.gov.bt/?page_id=116
Mainstreaming: Gender, Environment, Climate-change, Disaster, and Poverty	2015	https://www.undp.org/content/dam/bhutan/docs/Energy_environment/Env-publications/2013-2018-ECPM-Framework.pdf
Modernizing Weather, Water, and Climate Services: A roadmap for Bhutan	2015	http://www.nchm.gov.bt/home/pageMenu/32
National action plan biodiversity persistence and climate change	2011	http://www.nbc.gov.bt/wp-content/uploads/2010/06/National-Paper-on-Biodiversity-and-Climate-Change-_Bhutan1.pdf
National Adaptation Programme of Action and NAPA II		https://unfccc.int/node/61022
National Disaster Management Strategy		http://www.ddm.gov.bt/downloads
National Forest Inventory Vol I & II	2018	http://www.dofps.gov.bt/?page_id=116

National Integrated Water Resources Management Plan	2016	https://www.adb.org/projects/documents/bhu-46463-002-dpta
National Paper on Biodiversity Persistence & Climate Change, Climate Summit for A Living Himalayas	2011	http://www.nbc.gov.bt/wp-content/uploads/2011/05/Draft-national-paper-on-biodiversity-persistence-and-climate-change.pdf
Population and Housing Census	2017	http://www.nsb.gov.bt/publication/publications.php?id=2
Re-assessment of Potentially Dangerous Glacial Lakes	2019	http://www.nchm.gov.bt/home/pageMenu/32
Red Panda Action Plan	2018	http://www.dofps.gov.bt/?page_id=116
River Flow Status of Bhutan	2017	http://www.nchm.gov.bt/home/pageMenu/32
Snow Leopard Conservation Action Plan	2018	http://www.dofps.gov.bt/?page_id=116
Technology Needs Assessment & Technology Action Plans For Climate Change Adaptation	2013	https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TNR_CRE/
The 2030 Agenda for Sustainable Development		https://sustainabledevelopment.un.org/post2015/transformingourworld
The Middle Path, National Environment Strategy for Bhutan	1998	https://www.thegef.org/sites/default/files/ncsa-documents/Middle_Path.pdf
Tiger Action Plan for Bhutan	2018	http://www.dofps.gov.bt/?page_id=116
Twelfth Five-Year Plan 2018 – 2023 renewable natural resources sector	2018	https://www.gnhc.gov.bt/en/
World Bank Country Partnership Strategy 2014-2018: Bhutan, Climate Change Country Risk Assessment	2014-2018	http://documents.worldbank.org/curated/en/612871468205491416/Bhutan-Country-partnership-strategy-for-the-period-FY2015-19

14.2. Analytical Framework

Success Factor	Core Areas	Additional Questions	Ranking of present situation (0-5; weak-strong)	Examples illustrating ranking
Climate information	Assess the level of availability/ quality of existing climate projections.	Have the assessments accessed the vulnerabilities/ risks/ adaptive capacities of certain groups, for example women, children, differently abled persons and other vulnerable groups?		
	Assess the level of availability/ quality of existing vulnerability studies			
	What data is available to assess current and future climate risks and adaptation?			
Long term vision and mandate	Is there a long-term coherent existing national plan/ strategy on CCA? (incl. target areas and beneficiaries; responsible authorities; timing; activities; resources)?	If yes, please name the long-term strategy and responsible authority If no, please describe what steps could be taken to develop such a strategy		
	To what extent does the CCA plan/strategy consider long and medium-term impacts?			
	Are there institutional arrangements in Bhutan to coordinate, lead and monitor and sustain the NAP? Describe the institutional arrangement.			
Implementation	What is the quality of existing CCA projects?	Please briefly reflect on some examples of successful local level planning and implementation of an What are the challenges for an effective planning and adaptation implementation? Lessons from the past/adaptation measure		
	What is the volume of existing CCA projects? What is the level of coordination of CCA projects?			
Integration	What is the degree of integration of adaptation into national development strategy?	What are some of the main barriers to integrating/mainstreaming adaptation in Bhutan?		
	Has adaptation been prioritized in national planning? If yes, please			

	briefly explain how it has been prioritized			
Reporting, Monitoring and Review	Is there a national plan for monitoring and evaluation of adaptation in Bhutan?	If yes, please provide the name of the adaptation monitoring plan or how adaptation has been integrated into existing monitoring systems If no, please describe some of the steps that could be taken to develop such a plan or integrate it into existing systems		
	Has adaptation been integrated into existing national monitoring systems?			
Participation	Assess the degree of inclusion of vulnerable group concerns been address in climate adaptation strategies/planning (local and national)?			

Additional:

16. The National Adaptation Plan process is advised to be gender-sensitive, to what extent is Bhutan able to apply that approach? E.g. is there capacity to prepare and implement a gender-sensitive NAP in Bhutan?
17. What are some of the existing entry points for integrating climate change adaptation in national, sectoral and sub-national development planning (e.g. existing institutions, plans, policy processes, budgets etc.)?
18. What are the current sources of adaptation finance? How are these integrated into national planning and budgeting? Do they include gender considerations?

14.3. List and definitions for a core set of 27 descriptive indices of extremes defined by IPCC

User-friendly R-based software (RClimDex for their calculation is available, see <unfccc.int/NAP> for more details).

Temperature indices:

1. FD, frost days: count of days where TN (daily minimum temperature) < 0°C
   Let TNij be the daily minimum temperature on day i in period j. Count the number of days where TNij < 0°C.
2. SU, summer days: count of days where TX (daily maximum temperature) > 25°C
   Let TXij be the daily maximum temperature on day i in period j. Count the number of days where TXij >25°C.
3. ID, icing days: count of days where TX < 0°C
   Let TXij be the daily maximum temperature on day i in period j. Count the number of days where TXij <0°C.
4. TR, tropical nights: count of days where TN > 20°C
   Let TNij be the daily minimum temperature on day i in period j. Count the number of days where TNij >20°C.
5. GSL, growing season length: annual count of days between first span of at least six days where TG (daily mean temperature) > 5°C and first span in second half of the year of at least six days where TG <5°C.
   Let TGij be the daily mean temperature on day i in period j. Count the annual (1 Jan to 31 Dec in Northern Hemisphere, 1 July to 30 June in Southern Hemisphere) number of days between the first occurrence of at least six consecutive days where TGij > 5°C and the first occurrence after 1 July (1 Jan in Southern Hemisphere) of at least six consecutive days where TGij < 5°C.
6. TXx: monthly maximum value of daily maximum temperature:
   Let TXik be the daily maximum temperature on day i in month k. The maximum daily maximum temperature is then TXx = max (TXik).
7. TNx: monthly maximum value of daily minimum temperature:
   Let TNik be the daily minium temperature on day i in month k. The maximum daily minimum temperature is then TNx = max (TNik).
8. TXn: monthly minimum value of daily maximum temperature:
   Let TXik be the daily maximum temperature on day i in month k. The minimum daily maximum temperature is then TXn = min (TXik).
9. TNn: monthly minimum value of daily minimum temperature:
   Let TNik be the daily minimum temperature on day i in month k. The minimum daily minimum temperature is then TNn = min (TNik).
10. TN10p, cold nights: count of days where TN < 10^{th} percentile
    Let TNij be the daily minimum temperature on day i in period j and let TNin10 be the calendar day 10th percentile of daily minimum temperature calculated for a five-day window Center d on each calendar day in the base period n (1961-1990). Count the number of days where TNij < TNin10.
11. TX10p, cold day-times: count of days where TX < 10^{th} percentile
    Let TXij be the daily maximum temperature on day i in period j and let TXin10 be the calendar day 10th percentile of daily maximum temperature calculated for a five-day window Center d on each calendar day in the base period n (1961-1990). Count the number of days where TXij < TXin10.
12. TN90p, warm nights: count of days where TN > 90^{th}

Percentile Let TNij be the daily minimum temperature on day i in period j and let TNin90 be the calendar day 90th percentile of daily minimum temperature calculated for a five-day window Center d on each calendar day in the base period n (1961-1990). Count the number of days where TNij > TNin90.

13. TX90p, warm day-times: count of days where TX > 90th percentile
    Let TXij be the daily maximum temperature on day i in period j and let TXin90 be the calendar day 90th percentile of daily maximum temperature calculated for a five-day window Center d on each calendar day in the base period n (1961-1990). Count the number of days where TXij > TXin90.
14. WSDI, warm spell duration index: count of days in a span of at least six days where TX > 90th percentile
    Let TXij be the daily maximum temperature on day i in period j and let TXin90 be the calendar day 90th percentile of daily maximum temperature calculated for a five-day window Center d on each calendar day in the base period n (1961-1990). Count the number of days where, in intervals of at least six consecutive days TXij > TXin90.
15. CSDI, cold spell duration index: count of days in a span of at least six days where TN > 10th percentile
    Let TNij be the daily minimum temperature on day i in period j and let TNin10 be the calendar day 10th percentile of daily minimum temperature calculated for a five-day window Center d on each calendar day in the base period n(1961-1990). Count the number of days where, in intervals of at least six consecutive days TNij < TNin10.
16. DTR, diurnal temperature range: mean difference between TX and TN (°C)
    Let TXij and TNij be the daily maximum and minimum temperature on day i in period j. If I represents the total number of days in j then the mean diurnal temperature range in period j DTRj = sum (TXij – TNij)

Precipitation indices:

17. RX1day, maximum one-day precipitation: highest precipitation amount in one-day period
    Let RRij be the daily precipitation amount on day i in period j. The maximum one-day value for period j is RX1dayj = max (RRij).
18. RX5day, maximum five-day precipitation: highest precipitation amount in five-day period
    Let RRkj be the precipitation amount for the five-day interval k in period j, where k is defined by the last day. The maximum five-day values for period j are RX5dayj = max (RRkj).
19. SDII, simple daily intensity index: mean precipitation amount on a wet day
    Let RRij be the daily precipitation amount on wet day w(RR ≥ 1 mm) in period j. If W represents the number of wet days in j then the simple precipitation intensity index SDIIj = sum (RRwj) / W.
20. R10mm, heavy precipitation days: count of days where RR (daily precipitation amount) ≥ 10 mm
    Let RRij be the daily precipitation amount on day i in period j. Count the number of days where RRij ≥ 10 mm.
21. R20mm, very heavy precipitation days: count of days where RR ≥ 20 mm
    Let RRij be the daily precipitation amount on day i in period j. Count the number of days where RRij ≥ 20 mm.
22. Rnnmm: count of days where RR ≥ user-defined threshold in mm
    Let RRij be the daily precipitation amount on day i in period j. Count the number of days where RRij ≥ nn mm.
23. CDD, consecutive dry days: maximum length of dry spell (RR < 1 mm)
    Let RRij be the daily precipitation amount on day i in period j. Count the largest number of consecutive days where RRij < 1 mm.
24. CWD, consecutive wet days: maximum length of wet spell (RR ≥ 1 mm)
    Let RRij be the daily precipitation amount on day i in period j. Count the largest number of consecutive days where RRij ≥ 1 mm.
25. R95pTOT: precipitation due to very wet days (> 95th percentile)

Let RRwj be the daily precipitation amount on a wet day w (RR ≥ 1 mm) in period j and let RRwn95 be the 95th percentile of precipitation on wet days in the base period n (1961- 1990). Then R95pTOTj = sum (RRwj), where RRwj > RRwn95.

26. R99pTOT: precipitation due to extremely wet days (> 99th percentile)
    Let RRwj be the daily precipitation amount on a wet day w (RR ≥ 1 mm) in period j and let RRwn99 be the 99th percentile of precipitation on wet days in the base period n (1961- 1990). Then R99pTOTj = sum (RRwj), where RRwj > RRwn99.
27. PRCPTOT: total precipitation in wet days (> 1 mm)
    Let RRwj be the daily precipitation amount on a wet day w(RR ≥ 1 mm) in period j. Then PRCPTOTj = sum (RRwj).

Source: Klein Tank, A.M.G, F.W. Zwiers and X. Zhang. 2009. Guidelines on Analysis of extremes in a changing climate in support of informed decisions for adaptation. Climate Data and Monitoring WCDMP-No. 72, TD 1500. World Meteorological Organization, Geneva, Switzerland. Available at:

http://www.wmo.int/datastat/documents/ WCDMP_72_TD_1500_en_1_1.pdf