National Adaptation Plan (NAP) of the Kingdom of Bhutan

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Kingdom of Bhutan
First National Adaptation Plan
2023

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PREFACE

The first National Adaptation Plan (NAP) from Bhutan was prepared to (i) identify the adaptation plans, priorities and needs and (ii) enhance the process for planning and implementing these adaptation priorities in the medium to long run. The first NAP builds on Bhutan's experience in adaptation through the National Adaptation Programme of Action (NAPA) and other adaptation programs and projects. The NAP has been prepared in alignment with the requirements of Bhutan's Climate Change Policy 2020 to build the resilience and reduce vulnerability in Bhutan.

The NAP was prepared following the NAP Technical Guidelines of the LDC Expert Group (LEG) of the UN Framework Convention on Climate Change (UNFCCC) and the guidelines also informed the establishment of the NAP process in Bhutan. The first NAP from Bhutan is also responsive to the Paris Agreement with regards to the Adaptation Communication and reporting under the Enhanced Transparency Framework. As stated in the 1st and 2nd Nationally Determined Contributions from Bhutan, the Adaptation Communication is being conveyed through this NAP. The monitoring and evaluation component of the NAP and NAP process has also been designed to facilitate both national and international reporting requirements under the Climate Change Policy of Bhutan 2020 and the Paris Agreement respectively.

In this regard the first NAP is intended to guide the planning of adaptation in Bhutan through identification of priorities and needs and their implementation through integration into development plans at all levels. In this regard, the NAP will be prepared and updated every five years at the same frequency as the NDC to inform the five-year development planning process in Bhutan. The NAP is also intended to convey the priorities and needs for adaptation in Bhutan internationally through the channels provided under the UNFCCC and the Paris Agreement.

STATEMENT ON INCLUSION OF AN ADAPTATION COMMUNICATION IN THE NATIONAL ADAPTATION PLAN

In accordance with the Bhutan's Climate Change Policy 2020 and as stated in the 1st NDC and 2nd NDC, Bhutan's first Adaptation Communication is being conveyed as part of this first National Adaptation Plan (NAP). The Adaptation Communication is being conveyed as part of the NAP under the flexibility of vehicles for submission provided in Article 7 paragraphs 10 and 11 of the Paris Agreement.

The Adaptation Communication from Bhutan is being submitted as part of the NAP to:

i) reduce the burden of preparing two separate documents containing the same priorities and needs. The adaptation priorities and needs were prepared as part of a comprehensive national adaptation planning process (NAP Process) established in response to national and local needs and guided by the guidelines for the NAP process established under the UNFCCC through decision 5/CP.17.
ii) avoid confusion among local, national, and international stakeholders on the placement of the same adaptation priorities and needs in two separate nationally endorsed documents.

Therefore, in response to paragraph 10 of Decision 9/CMA.1 the identification of the elements of Bhutan's First Adaptation Communication to the Paris Agreement as within the first NAP is as follows[1]:

	Elements of an adaptation communication (in Annex to Decision 9/CMA.1)	Corresponding sections of the First National Adaptation Plan
(a)	National circumstances, institutional arrangements and legal frameworks;	Chapter 1 of NAP
(b)	Impacts, risks and vulnerabilities, as appropriate;	Chapter 2 of NAP
(c)	National adaptation priorities, strategies, policies, plans, goals and actions;	Chapter 1 describes the overall national priorities and policies. Chapter 3 of NAP summarises the adaptation priorities and plans. Chapter 4 presents the strategies for implementation of the adaptation priorities and needs.
(d)	Implementation and support needs of, and provision of support to, developing country Parties;	Chapter 3 of NAP contains a description and summary of the support needs. Part II contains the detailed tables for adaptation support needs
(e)	Implementation of adaptation actions and plans, including:	A stock take for the NAP process was conducted prior to preparation of the NAP and contains an overview of

[1] *As per decision 9/CMA.1, elements referred to in paragraph (a) through (d) of the annex should be provided and elements in paragraphs (e) through (i) are additional elements to be provided as appropriate.*

		the progress, gaps, barriers, challenges, and lessons. The document is available separately on the Bhutan Climate Portal developed as part of enabling activities to support Bhutan's NAP process. Visit www.nec.gov.bt for the link to the Bhutan Climate Platform.
	(i) Progress and results achieved;	*As above. The 2nd NAP/Adaptation Communication will contain any future outcomes as appropriate.*
	(ii) Adaptation efforts of developing countries for recognition;	*As above. The 2nd NAP/Adaptation Communication will contain any future outcomes as appropriate.*
	(iii) Cooperation on enhancing adaptation at the national, regional and international level, as appropriate;	*As above. The 2nd NAP/Adaptation Communication will contain any future outcomes as appropriate.*
	(iv) Barriers, challenges and gaps related to the implementation of adaptation;	*As above. The 2nd NAP/Adaptation Communication will contain any future outcomes as appropriate.*
	(v) Good practices, lessons learned and information-sharing;	*As above. The 2nd NAP/Adaptation Communication will contain any future outcomes as appropriate.*
	(vi) Monitoring and evaluation;	Chapter 5 of NAP and as above. *The 2nd NAP/Adaptation Communication will contain any future outcomes as appropriate.*
(f)	Adaptation actions and/or economic diversification plans, including those that result in mitigation co-benefits;	Several adaptation priorities such as diversification of energy sources, securing watersheds, conservation of forests, sustainable land and soil management, and promotion of green infrastructure in urban areas result in mitigation co-benefits. See Chapter 3 for details.
(g)	How adaptation actions contribute to other international frameworks and/or conventions;	Several adaptation priorities as detailed in Chapter 3 such as for forest and biodiversity as aligned with the NBSAP contribute to the Convention on Biological Diversity. Priorities identified for disaster risk reduction are in line with the National Disaster Risk Management Strategy and the Sendai Framework for Disaster Risk Reduction
(h)	Gender-responsive adaptation action and traditional knowledge, knowledge of indigenous peoples and local knowledge systems related to adaptation, where appropriate;	Gender considerations, traditional and local knowledge are integrated into the priorities and plans and throughout various chapters of the NAP. Text Box 3 describes how gender considerations were included the NAP.
(i)	Any other information related to adaptation.	--

ABBREVIATIONS AND ACRONYMS

ABI	Association of Bhutanese Industries
ADCOM	Adaptation communication
BAFRA	Bhutan Agriculture and Food Regulatory Authority
BCCI	Bhutan Chamber of Commerce and Industries
BTFEC	Bhutan Trust Fund for Environmental Conservation
BTR	Biennial Transparency Report
C4	Climate Change Coordination Committee
CFMG	Community Forest Management Groups
CMA	Conference of the Parties serving as the meeting of the Parties to the Paris Agreement
COP	Conference of the Parties
CSO	Civil Society Organisation
CST	College of Science and Technology
DAMC	Department of Agricultural Marketing and Cooperatives
DECC	Department of Environment and Climate Change (Secretariat of NEC)
DoLGDM	Department of Local Governance and Disaster Management
DGPC	Druk Green Power Corporation
DHI	Druk Holdings and Investment
DHPS	Department of Hydropower and Power Systems
DoA	Department of Agriculture
DoFPS	Department of Forests and Park Services
DoI	Department of Industries
DoL	Department of Livestock
DPO	Disabled People's Organisation of Bhutan
DRC	Department of Revenue and Customs
DRE	Department of Renewable Energy
ETF	Enhanced transparency framework (under the Paris Agreement
FI	Financial Institutions
FYP	Five-year plan
GCF	Green Climate Fund
GEF	Global Environment Facility
GovTech	Government Technology Agency
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
KGUMSB	Khesar Gyalpo University of Medical Sciences of Bhutan
LDC	Least developed country
LEDS	Low emission development strategy
LEG	Least Developed Countries Expert Group
LG	Local Government
LTS	Long-term low greenhouse gas emission development strategies
MBOs	Mutual Benefit Organisations
MoFAET	Ministry of Foreign Affairs and External Trade
MoAL	Ministry of Agriculture and Livestock
MoENR	Ministry of Energy and Natural Resources
MoICE	Ministry of Industry, Commerce and Employment
MoH	Ministry of Health
MoHA	Ministry of Home Affairs
MoIT	Ministry of Infrastructure and Transport
MRG	Mainstream Reference Group
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Action
NBC	National Biodiversity Center

NCAH	National Center for Animal Health
NCHM	National Center for Hydrology and Meteorology
NCWC	National Commission for Women and Children
NDC	Nationally Determined Contribution
NEC	National Environment Commission
NECS	National Environment Commission Secretariat
NHRDC	National Highland Research Development Center
NKRA	National Key Result Areas
NPPC	National Plant Protection Center
NPRDC	National Poultry Research and Development Centre
NRDCAN	National Research and Development Centre for Animal Nutrition
NRDCL	Natural Resources Development Corporation Ltd.
NSB	National Statistics Bureau
NSSC	National Soil Service Center
NWFP	Non-Wood Forest product
OCASC	Office of Cabinet Affairs and Strategic Coordination
OYE	Organisation for Youth Empowerment
PA	Paris Agreement
PWD	Persons With Disabilities
RCDC	Royal Center for Disease Control
REDD+	Reducing emissions from deforestation; reducing emissions from forest degradation; conservation of forest carbon stocks; sustainable management of forests; and enhancement of forest carbon stocks (decision 1/CP.16, para. 70)
RENEW	Respect, Educate, Nurture and Empower Women
RGOB	Royal Government of Bhutan
RLDC	Regional Livestock Development Center
RMA	Royal Monetary Authority
RNR	Renewable Natural Resources
RSSC	Royal Society for Senior Citizens
SDG	Sustainable Development Goals
SLM	Sustainable Land Management
SNC	Second National Communication
TNC	Third National Communication
UNDP	United Nations Development Programme
UNFCCC	United Nations Convention on Climate Change
V&A	Vulnerability and Adaptation
VDCP	Vector-borne Disease Control Program
WASH	Water, Sanitation, and Hygiene
WBIs	Wood- Based Industries
YDF	Youth Development Fund

Glossary of Dzongkha Terms

Dzongkhag	District
Geog	Smaller administrative unit comprising multiple villages

FOREWORD

Climate change is a long-term threat to sustainable development and the wellbeing of Bhutan and its citizens. The achievements of Bhutan over the past decades in sustainable development may be derailed by the adverse impacts of climate change. The first National Adaptation Plan (NAP) builds on Bhutan's experience with adaptation with the National Adaptation Programme of Action (NAPA) and other adaptation initiatives.

The NAP presents Bhutan's national circumstances, vision, and objectives for adaptation in the medium to long-term, the key priorities and needs for adaptation and the enabling activities needed to support a long-term adaptation process. The NAP will inform national stakeholders about national priorities for adaptation and guide the implementation of these priorities through integration into national, regional, sectoral, and local plans. Internationally, the NAP will also inform our development partners who support Bhutan's development process about our needs for climate change adaptation.

This first NAP from Bhutan also serves as our first Adaptation Communication under the Paris Agreement to convey our priorities and needs for adaptation. The decision to submit the NAP as the Adaptation Communication is based on the need to reduce the burden of preparing separate reports and to avoid confusion between different documents containing the same national adaptation priorities and needs. In addition, the monitoring and reporting chapter of the NAP has been developed to facilitate future reporting requirements on adaptation under the Enhanced Transparency Framework of the Paris Agreement.

The NAP was developed in line with national processes and priorities and was guided by guidance from the UNFCCC process by a national team as part of the NAP readiness project. The NAP preparation was delayed over the past few years due to the COVID-19 Pandemic. Nevertheless, the preparation of the NAP followed a rigorous process of technical assessments, consultations with a wide range of stakeholders across different sectors, national agencies to regional and local planners, civil society, and the private sector.

I would like to express my appreciation to the NAP drafting team, the thematic working groups, and the project support team from the NEC Secretariat and UNDP and all stakeholders and reviewers for their contribution for producing the first NAP from Bhutan. I would also like to thank the UNDP and GCF for the financial support for Bhutan's NAP readiness program. I look forward to continued support for the NAP process and implementation of the NAP to reduce Bhutan's vulnerability to climate change.

Lyonpo Dr. Tandin Dorji
Chairman, National Environment Commission and
Minister, Ministry of Foreign Affairs and External Trade.

EXECUTIVE SUMMARY

Bhutan has made remarkable socio-economic advancements over the past decades and is on the cusp of graduating from its status as a least developed country. However, the adverse impacts of climate change can reverse Bhutan's hard-won gains in socio economic development and poverty alleviation. The COVID-19 pandemic has negatively affected the economy in the short to medium term but the threat from climate change will remain for the long term with impacts and risks increasing over the coming decades. It is in view of this long-term threat from climate change to the wellbeing and prosperity of Bhutan and its people that the National Adaptation Plan (NAP) has been developed.

Bhutan's NAP has been prepared following international guidance and support from the UN Framework Convention of Climate Change (UNFCCC) process and is based on national development objectives and priorities. The NAP contains five chapters covering (i) national circumstances and objectives for adaptation, (ii) overview of climate projections, impacts and vulnerabilities, (iii) a comprehensive list of adaptation needs and priorities for the country, (iv) implementation strategy, and (v) a framework for monitoring and evaluation.

Introduction: Long term adaptation and the NAP process

The process to formulate and implement NAPs, known as the "NAP process", was established under the UNFCCC to facilitate adaptation in least developed countries and other developing countries. The agreed objectives of the NAP process are:

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, in particular development planning processes and strategies, within all relevant sectors and at different levels, as appropriate.

The principles of the NAP process are that national adaptation planning will be country driven, gender sensitive, participatory, and fully transparent, taking into consideration vulnerable groups, communities, and ecosystems. The process is to be based on and guided by the best available science, taking into account traditional and indigenous knowledge.

As climate change is a long-term challenge to socio-economic development, adaptation planning and implementation must become a regular consideration in economic and development planning processes. It is expected that over the coming decades several NAPs will be developed in an iterative and progressive manner to inform and guide adaptation and development. Therefore, the NAP process seeks to enhance coherence of adaptation and development planning to reduce duplication of efforts and enhance synergies. The long-term adaptation process also requires going beyond simply identifying and implementing adaptation projects. To ensure a sustainable and effective NAP process, the enabling environment to support informed adaptation planning and implementation on a continual basis must also be strengthened.

Based on these principles and ground realities, Bhutan's vision for climate change action as defined in the Climate Change Policy is:

"A prosperous, resilient and carbon neutral Bhutan where the pursuit of gross national happiness for the present and future generations is secure under a changing climate."

The purpose of the NAP is:

"*to protect the health, lives, livelihoods and happiness of the people of Bhutan from the adverse impacts of climate change by building adaptive capacity and enhancing resilience to reduce vulnerability and by integrating adaptation actions into the development planning process at all levels."*

The objectives of Bhutan's NAP process are to:

1. *Ensure a continuous, progressive, and iterative process to assess the vulnerability and adaptation needs across all sectors and levels in Bhutan recognising the special needs of vulnerable groups through the National Adaptation Plan process.*
2. *Promote the integration of climate change adaptation planning and implementation of adaptation actions into national and local level plans where possible.*
3. *Enhance the climate information and knowledge system to support a long-term, iterative process of adaptation planning and implementation.*
4. *Assess progress in adaptation including measurement of resilience and to climate change.*

The NAP as a vehicle for Bhutan's "Adaptation Communication"

While the NAP process was established under the UNFCCC to facilitate adaptation at a national level, Adaptation Communications were defined under the Paris Agreement to enhance adaptation action and provide a way for Parties to internationally communicate their adaptation priorities and needs. The Paris Agreement allows flexibilities for parties to submit these adaptation priorities and needs through several vehicles including as stand-alone Adaptation Communications, as a part of the National Communications or as a component of Nationally Determined Contributions.

Bhutan has decided to submit the Adaptation Communication to the Paris Agreement as part of its NAP. This is intended to reduce the burden of formulating two separate documents on adaptation priorities and avoid any potential for confusion in communication of adaptation priorities to national and international stakeholders. Towards this end, a "*Statement on inclusion of an Adaptation Communication in the National Adaptation Plan*" is presented in this NAP document.

Climate Risks and Vulnerabilities

The climate risks and vulnerabilities are presented in Chapter 2. While long-term historical climate data is not available in Bhutan, recent analysis using alternative global datasets provides historical and projected climate scenarios. Analysis by National Center for Hydrology and Meteorology (NCHM) indicates an increasing trend in temperature from 1976-2005 over and annual average temperature has increased by 0.8 degrees Celsius. Seasonal temperature has also increased with winters warming by 1.3 degrees. Rainfall patterns indicate a decrease in average annual rainfall and high seasonal variability with wet monsoons and dry winters. Projections of future climate indicate a consistent increase in temperature over the country based on two projections. One projection (RCP 4.5) indicates warming of about 0.8°C– 2.8°C during 2021-2100 while projections under RCP 8.5 scenario show increases of about 0.8°C to more than 3.2°C towards the end of the century.

Climate risk assessments (CRA) were conducted as part of the NAP preparation process with four technical reports prepared for agriculture, forest fires, human health, and water resources. A report on climate change vulnerability analysis and mapping was also prepared to assess vulnerable regions across the country. In addition, past vulnerability assessments prepared for the Third National Communication (TNC) to the UNFCCC and other sectoral reports were reviewed to inform the preparation of this NAP. Vulnerability of sectors across Bhutan are as follows:

- *Water:* Water is a cross cutting issue that affects all other sectors ranging from human settlements, food production, energy, industry, and ecosystems. Drying of water sources and decreasing winter precipitation is already observed in recent years, the climate risk assessment indicates further increase in duration and frequency of dry spells can lead to risk of local water shortages and increased drying of water sources. While flash floods and landslides are now already frequent climate induced hazards and affect human settlements and infrastructure, increase in annual precipitation and erratic precipitation is expected leading to more intense and frequent extreme events. The risk of Glacial Lake Outburst Floods (GLOF) is also likely to increase.

- Agriculture: About half the Bhutanese population are engaged in agriculture but is highly vulnerable to climate change. Climate induced water shortages, wildlife depredation, pests and diseases, poor mountainous soils are present vulnerabilities and constraints for food production. Risk of erosion from increased precipitation in wet season threatens the poor and shallow soils. While crop models using only temperature and precipitation data indicates a potential increase in areas for production of cereals, vegetables, fruits, and spices, the models were limited by absence of other key data such as soils, pests, diseases, extreme events, and land suitability and availability. It is anticipated that negative impacts will outweigh any positive benefits in agriculture.

- Forests and biodiversity: Bhutan's forests cover most of the country's land area (70.77%) and is a major factor in Bhutan achieving carbon neutral status. The forests are also a source for natural resources such as timber, non-wood forest products and other ecosystem services including as a store for fresh water. Furthermore, the different forests provide a variety of habitats for the rich biodiversity of Bhutan. Climate change poses great risk to forests and biodiversity, through potential changes in habitats and ecosystem functions. Forest fires are the most common and frequent threats to the forests and occur almost every year. Warmer and drier conditions in the dry season under climate change will increase the intensity and frequency of forest fires. The current risk of forest fire is concentrated in chir pine and blue pine forests, but the broad-leaved forests are expected to be at most risk by the 2nd half of this century. The increasing risks of forest fires not only threatens biodiversity, human settlements, and cultural heritage sites, but could also jeopardise Bhutan's carbon sinks and compromise the constitutional mandate to maintain 60% forest cover.

- Energy: Almost 100% of electricity generation in Bhutan is from hydropower and contributes to Bhutan to remaining a carbon neutral country. Hydropower development has been a major driver of economic growth and the sales and export of hydropower is a significant source of national revenue. While generation of hydroelectricity is much lower in winter, climate change is expected to worsen the situation with projections of drier winters. Increasing intensity of monsoons, increased sedimentation can also increase maintenance costs of hydropower plants, while the risk of GLOF threatens such large investments. As hydropower is highly vulnerable to climate change,

adaptation measures are required to safeguard existing investments and to diversify the energy mix.

- Human Health: Climate impacts on human health are starting to manifest in terms of increasing risks of vector- and water-borne diseases, and direct impacts on lives from climate induced disasters. Other emerging threats that have come to the fore in the light of the COVID-19 pandemic include risk of zoonosis events because of changing wildlife habitats and increasing intersection between wildlife, livestock, and human settlements. Heat waves, flash floods and landslides threaten human life, health, and wellbeing and affect health infrastructure. Vector borne diseases (malaria, dengue and to a lesser extent chikungunya, Japanese encephalitis, kala-azar, and scrub typhus) and water borne diseases (diarrhoea, dysentery, typhoid, cholera) are prevalent in Bhutan and are sensitive to climate change. While government programs have controlled malaria, incidences may double in the next 30 years to 150 case per year from present levels. Dengue in Bhutan was first reported in 2004 and under climate change can increase to about 3000 incidences per year by 2050. While vector borne diseases are endemic to the southern border with India, the spatial range is also expected to increase to other dzongkhags with higher elevations.

Adaptation Priorities, Needs, and Enabling Activities

Chapter 3 of the NAP presents summaries of two sets of support needs. The first part of the chapter presents a range of adaptation priorities and needs across sectors as measures to reduce vulnerability. The second half of the chapter presents enabling activities to support the NAP process over the long term to ensure informed and effective adaptation planning and implementation. Further details of the adaptation priorities need and enabling activities are presented in part two of the NAP document with expanded tables and details.

Adaptation priorities are identified across seven sectors as follows:

i) Water: The priorities in the water sector are cross cutting and involve many sectors and stakeholder groups. The adaptation priorities in water sector take a holistic approach including nature-based solutions. The interventions range from securing and managing natural sources of water to ensuring optimal use and management of water for drinking. Ensuring efficient and sustainable use of water for agriculture and other key infrastructure investments is included for the water sector to ensure an integrated approach to water management. The management of water discharge after consumption for human needs is covered in the priorities for human settlements. The strengthening of institutional capacity for water management including enhancing existing institutions like water user groups, strengthening capacity of key stakeholders and continuing research is essential to support a continuous and iterative adaptation.

ii) Agriculture and livestock: The adaptation priorities for both agriculture and livestock are grouped in interventions for securing the resource base, managing losses from climate impacts and emerging threats, and enhancing resilience in food production. The interventions include integrated landscape approaches including sustainable land management, appropriate technologies, and management practices. The agriculture and livestock sector presents strong synergies for climate mitigation through landscape approaches such as agroforestry, sustainable soil and land management, promotion of organic and good agricultural management practices. The role of the private sector is identified in several areas of food production, market access,

supply chain for the sector and risk management. Opportunities for integration of gender issues through appropriate technologies and engagement of women's groups are also identified. Recent lessons from the COVID-19 pandemic such as risks in supply chain, food banking and risk of zoonotic events have also been integrated. Targeted training at sector and the decentralised level is also required for enhanced risk assessments and adaptation implementation.

iii) Forests and Biodiversity: The adaptation priorities for forests and biodiversity are developed in a highly synergistic approach and contributes to mitigation (carbon sink management) in line with the National REDD+ Strategy (NRS), biodiversity conservation in line with the National Biodiversity Strategy and Action Plan (NBSAP), and disaster risk management. The interventions also aim to engage communities, private sector, and vulnerable groups as partners in management of the natural resources through people-centric programs. Opportunities to integrate gender responsive measures have also been included to the extent known and possible. The adaptation priorities address the great risk from forest fires, enhancing the assessment and monitoring of biodiversity under climate change, along with restoring and managing important areas and components of biodiversity in Bhutan. Invasive alien species and other emerging risks like zoonosis and spread of pest and diseases have also been identified in the wake of the COVID-19 pandemic. Key interventions also include management of forest and biodiversity through scientific sustainable management and community engagement.

iv) Human Settlements: With a rapidly urbanising population, climate proofing existing urban areas and other critical infrastructure is essential, as is preparing and implementing strategic plans for urban areas and human settlements. There are great synergies for mitigation and adaptation in urban areas and human settlements, for example, energy savings from residential and commercial areas due to energy efficiency and renewable energy generation (solar roofs) reduce the uncertainty of hydropower and function as both adaptation and mitigation measures. Securing ecosystem services in the form of '*green infrastructure*' around and within human settlements are nature-based solutions for both mitigation and adaptation. The adaptation priorities for human settlements centre around developing climate smart cities and human settlements that leverages green infrastructure and ecosystem-based adaptation. Climate proofing existing critical infrastructure such as roads, bridges, houses, industrial areas, and agricultural infrastructure is also needed. Measures are identified to adapt to increasing floods, landslides, windstorms, and urban heat island effects. Besides hard infrastructure investments, soft interventions like risk assessments, research and data, policies and regulations and preparedness are also identified to enhance climate resilience in human settlements.

v) Human Health: Measures for the health sector include surveillance and control of climate sensitive diseases, building resilience of critical public health infrastructure against extreme events and long-term climate risks. Enhancing health emergency preparedness to respond to climate induced disaster and enhancing surveillance and management of climate sensitive and vector borne diseases is needed. Further research and capacity building of the health sector is needed since the topic of climate risk integration is a fairly new topic among health professionals and practitioners in Bhutan. The health sector also depends on cross sectoral collaboration and coordination, since the determinants of health fall on other sectors and agencies, such as through Water, Sanitation and Hygiene (WASH) facilities, design of the living environment and disaster risk reduction and management. In the health sector, stakeholders have identified the participation of senior citizens

and retired professionals as partners to fill in gaps in specialised capacity and provide support in outreach and advocacy to vulnerable groups.

vi) **Energy:** Since Bhutan is almost completely dependent on hydropower, a climate sensitive sector, for electricity generation, adaptation for the energy sector is a two-pronged strategy of climate proofing hydropower investments and diversifying energy sources beyond major hydropower project by developing and scaling up alternative renewable energy programs. These adaptation measures have mitigation co-benefits, but adaptation in the sector is equally important to ensure energy security. The priority measures for hydropower are based on the priorities identified in the technical assessment for water sector as part of the NAP readiness project, 2nd NDC, Third National Communication and the Sustainable Hydropower Development Policy.

vii) **Climate Services and Disaster Risk Reduction:** Priorities under climate services and disaster risk reduction is cross cutting and concerns all sectors. The challenging mountainous environment of Bhutan with tremendous variation in topography creates challenges for providing weather and climate forecast and early warning services. Greater enhancement of climate studies including hydrological studies, improvements in climate projections and better early warning systems is a critical need. Climate induced hazards will also affect all sectors of the economy, society and particularly the vulnerable groups. While floods, landslides and forest fires are familiar climate induced hazards in Bhutan that are increasing in intensity and frequency, the increasingly erratic nature of monsoon onset and retreat threatens farmers and food security. Therefore, the key stakeholders in leading these interventions range from NCHM, Department of Agriculture and Department of Local Governance and Disaster Management, in collaboration with all relevant stakeholders. The adaptation priorities for climate services and disaster risk reduction, focus on improving hydrological services for water resources management, strengthening of agro-met services and climate information system, and improvements for efficient flood forecasting and preparedness. Interventions to protect critical infrastructure and settlements also requires improved flood forecasting and preparedness and response systems, along with enhanced early warning, response, and recovery capacity.

Enabling activities to support the NAP process in Bhutan are grouped across five types of interventions.

i) **Policy and institutional support:** To ensure NAP process for the long term, some of the key enabling activities are strengthening the policy and institutional environment. Key priorities include enhancing institutional capacity to facilitate the integration of adaptation planning and implementation at all levels from national to local government institutions. A review of all relevant policies and legislation is also identified to ensure coherent climate action. Enhancing and building on ongoing efforts to ensure collaboration and coordination of adaptation among the many stakeholders across sectors and different levels is also a priority to minimise overlaps, duplications, and avoidance of maladaptation. Civil society and the private sector are identified as partners for adaptation and the enhancement of their engagement and capacity is a priority to support the NAP process.

ii) **Monitoring and evaluation process:** A robust M&E system is identified as a key requirement to ensure that adaptation plans and priorities are implemented at all levels and by all key stakeholders and that intended objectives are being met. The M&E system for the NAP process in Bhutan covers three levels of processes (i) monitoring progress in the implementation of this NAP

document (ii) establishing a national system for measurements of resilience and vulnerability at a higher level (iii) developing and building a national M&E system that not only supports national requirements in line with the Climate Change policy, but also supports international reporting requirements under the Enhanced Transparency Framework of the Paris Agreement. All proposed M&E systems are intended to build on existing national M&E and reporting systems and other sector level M&E frameworks such as the Bhutan Water Security Index. The M&E process also includes the processes for taking stock of the iterative NAP cycle and processes for preparation of the 2nd NAP for Bhutan.

iii) Research and data: Informed decision making and planning for adaptation with the best available science has been strongly recommended in the NAP guidelines of the UNFCCC and through the consultations. In this regard, the research and data will be developed by implementing the "*Roadmap and Strategy for Strengthening Climate Change Research in Bhutan, 2020*". The priorities cover three main areas of interventions (i) Conducting specific needs-based research for the different sectors and stakeholders. (ii) dissemination of the results and information through the Bhutan Climate Platform and through education and outreach programs (ii) strengthening research for climate change adaptation in Bhutan through institutional strengthening and enhancing the Bhutan Science Foundation. The climate research roadmap is led by the Royal University of Bhutan through its associated institutions and other collaborating agencies.

iv) Capacity building: Continuing capacity building is required to ensure that new actors can be effective adaptation planners and implementers, while skills and capacity will need to be upgraded for others with continually emerging new findings, methodologies, and techniques for adaptation practice. While some level of targeted capacity building has been included in the sectoral and thematic adaptation priorities, overall capacity building for the NAP process is based on the "*Skills Assessment for the NAP Process in Bhutan (SANP) 2020*". To fill the gaps and needs identified in the SANP, the priorities include (i) integration of climate change adaptation learning into the national education and training systems (ii)developing an institutional memory for climate change adaptation by building cohorts of training of trainers and modules in relevant institutions. (ii) promoting the awareness and utilization of indigenous/ traditional knowledge systems and (iv) ensuring sustainability with a financial strategy to sustain climate change skills development.

v) Education and awareness: As elaborated in the chapter 4 (Implementation Strategies), education and awareness for key stakeholders along with awareness about climate change and adaptation among the public is critical to ensure buy- in and support for the NAP process. The strategy for this priority includes (i) integration of climate change adaptation into education curriculum (ii) enhancing the skills pool for climate change adaptation planning and research through targeted scholarships (iv) conducting advocacy campaigns on climate change adaptation, preparedness, and early warning as part of the communication strategy. Key partners in education and awareness include CSOs, the media and media production houses from the private sector.

Implementation strategy

The implementation strategy for the NAP is based on the overall objectives of the NAP process to reduce vulnerability and increase resilience through integration with development planning. The implementation approach is also guided by the Climate Change Policy which recognises that climate change is a cross cutting issue and identifies approaches and the key stakeholders for implementation. In implementing the NAP, both adaptation priorities across sectors (hard investments) and enabling actions (soft programs) will be implemented. The priorities with concrete adaptation programs and activities in Chapter 3 and the soft components (enabling activities) to support the NAP process to ensure that adaptation in the long run is sustained and responsive to the changing risks and needs in the medium to long run.

At an operational level, government agencies will have to first integrate climate change actions identified in the NAP and NDC into national plans and programs and then secure funding for the programs in line with national procedures for planning and budgeting. In this regard, this chapter identifies the possible entry points to integrate the adaptation priorities into national and local development plans.

Several approaches to integrate the numerous adaptation priorities in a holistic and programmatic manner are identified as possible options for future five-year development plans or other thematic and sectoral development plans. While subsequent financing of the plans will follow the integration into national plans, several potential sources for climate financing from multilateral and bilateral channels have been presented. Several potential innovative national mechanisms for climate financing such as the Bhutan Climate Fund and the Green Finance Roadmap are also identified as potential financing channels for adaptation in Bhutan.

For the NAP to be successfully implemented, concerted communication and outreach effort is essential to build awareness and support for integration of adaptation into national plans and policies. The roles of key agencies and stakeholders in leading facilitating, implementing, and financing of the NAP are also presented in this Chapter.

Some key issues to be noted for successful implementation identified for the NAP are:

- It is important to avoid “maladaptation” where poorly made decisions for investment and projects may lead to increased risk of adverse climate impacts. Maladaptation occurs through actions, or inactions in development plans or other interventions that are poorly planned and/or ignore climate hazards and risks.
- Integration of adaptation priorities (and low emission development plans) into major national development plans such as the transformative initiatives is essential. Such integration of climate priorities is needed to climate proof major economic investments, maximise use of limited resources and reduce duplication.
- Inclusion of key stakeholders including the private sector, civil society, and the most vulnerable groups (elderly, women, and youth) in adaptation planning is required for buy-in and support from these key stakeholders and beneficiary groups.

Monitoring and Evaluation

The final chapter of the NAP covers monitoring and evaluation (M&E) to ensure implementation of the NAP and to learn from the experience of the first NAP to inform subsequent iterations of the NAP. The M&E process is based on the Climate Change Policy 2020 and is intended to facilitate future monitoring and reporting obligations under the Paris Agreement.

The M&E framework in Bhutan's NAP is at three different levels:

- **Monitoring and evaluation of the NAP:** The 1st level is M&E of the NAP to ensure the implementation of both adaptation priorities and enabling activities identified in chapter 3. The NAP M&E will also assess adequacy of support received for implementation of the NAP and assess gaps and barriers for implementation. The role of various national coordinating bodies such as National Environment Commission, Climate Change Coordination Committee (C4), and other agencies are identified. The modalities include review and stock taking and reporting to national bodies in line with the Climate Change Policy. A timeline for review and revision of NAP is also defined, and it is expected that a new iteration of the NAP is to be developed by end of year five. There will be a mid-term review and stock take to inform the process.

- **M&E for National Reporting under Climate Change Policy**: The 2nd level is monitoring and reporting on adaptation action at the national level in line with the national climate change policy. The M&E of this section elaborates the monitoring and reporting requirements of the Climate Change Policy which mandates reporting on progress in climate action to the National Climate Change Committee, Cabinet and Parliament. A key part of measuring climate action in this regard includes assessing "*progress in adaptation including measurements of resilience to climate change*" to meet the NAP objective to "*reduce vulnerability to the impacts of climate change by building adaptive capacity and resilience"*. Following an examination of various options for assessing progress on adaptation and the experience in preparing the NAP in Bhutan, it is recommended that a system for measuring climate resilience be developed based on the approach already undertaken in the "Climate Change Vulnerability Analyses (CCVA) and Mapping for National Adaptation Plan (NAP) formulation process in Bhutan" (NEC 2021). A second component of this level of reporting is tracking support received for adaptation and is intended to support future national reporting obligations to the Paris Agreement.

- **M&E to support international reporting under the Paris Agreement**: The 3rd level for the NAP M&E is to facilitate reporting at the international level under the Paris Agreement, where all parties have obligations for submission of Biennial Transparency Reports as part of the Enhanced Transparency Framework. Components of reporting on progress in adaptation and finance and technical support received must be reported and the M&E framework is intended to facilitate this international aspect of monitoring and reporting.

PART I:

First National Adaptation Plan of Bhutan

1. INTRODUCTION

As a small landlocked country with a fragile mountainous ecosystem, and with high reliance on climate sensitive sectors such as hydropower and agriculture, the Kingdom of Bhutan is particularly vulnerable to the adverse impacts of climate change. Bhutan made remarkable socio-economic advancements over the past decades and is on the cusp of graduating from its status as a least developed country. The COVID- 19 pandemic has crippled the economy adding to the economic vulnerability of Bhutan's least developed country status. However, in the medium to long term, the adverse impacts of climate change can reverse the hard-won gains in socio economic development and poverty alleviation in Bhutan. It is in view of this long-term threat from climate change to the wellbeing and prosperity of Bhutan and its people, that the National Adaptation Plan (NAP) has been developed to build adaptive capacity and resilience.

Bhutan's NAP builds on the experience of Bhutan in implementing adaptation projects under the National Adaptation Program of Action (NAPA) and the latest climate risk assessments in key sectors undertaken under the NAP Readiness Project. The NAP consolidates the priority actions and needs from these recent assessments as well as the adaptation priorities previously conveyed in the 1st NDC (2015), as in the Third National Communication. The priorities, needs and implementation strategy in this NAP was developed through a highly consultative process and aims to reduce Bhutan's vulnerability to climate change by building adaptive capacity and enhancing the enabling environment to support a long-term NAP process.

1.1 VISION, PURPOSE, AND OBJECTIVES

Bhutan's vision, goals and principles and objectives for climate action are defined in the Climate Change Policy 2020. The climate change policy was adopted to ensure that Bhutan's pursuit of "ecologically balanced sustainable development" is resilient and contributes to the goal of remaining carbon neutral. The policy provides strategic guidance for climate change action and has the dual purpose of supporting the national development imperative and responds to international commitments for climate change action under the UN Framework Convention on Climate Change (UNFCCC) and the Paris Agreement.

The policy defines the objectives for mitigation and adaptation actions and outlines the requirements for implementation and coordination of climate action in Bhutan. Therefore, the overall vision and objectives for Bhutan's NAP is defined by the climate change policy 2020 as follows:

VISION

Bhutan's vision for climate change action is:

> *"A prosperous, resilient and carbon neutral Bhutan where the pursuit of gross national happiness for the present and future generations is secure under a changing climate."*

PURPOSE

The purpose of the NAP is:

> *"to protect the health, lives, livelihoods and happiness of the people of Bhutan from the adverse impacts of climate change by building adaptive capacity and enhancing resilience to*

reduce vulnerability and by integrating adaptation actions into the development planning process at all levels."

This purpose has been based on the mandate on adaptation for the Royal Government of Bhutan (RGOB) under policy objective 2 of the climate change policy, "Building resilience to climate change". This mandate contextualises the rationale for adaptation in Bhutan by recognising that climate change adaptation is a localised action that is needed to safeguard the wellbeing of the Bhutanese people to a global threat emanating from actions beyond its borders.

Objectives

These objectives and statements for adaptation are based on the policy statements for building climate resilience in Bhutan[2]. The statements also build on the principles and objectives of the NAP as defined under the UNFCCC and recognise the long-term nature of climate change and its linkage and implications on the national development process. It is with this long-term view required for adaptation that the first NAP for Bhutan has been developed.

Based on the above objectives, Bhutan's NAP describes (i) the national circumstances including institutional and policy arrangements for a continuous and iterative process for adaptation planning and implementation (ii) priorities and needs to build adaptive capacity and climate resilience including the enhancement of the enabling environment to support the NAP process (iii) an implementation strategy to ensure the priorities in the NAP can be implemented and (iv) a monitoring and evaluation systems to support the NAP Process in Bhutan.

1.2 NAP Mandates and Policy Alignment

As described in the section on vision, purpose and objectives, the NAP process in Bhutan is defined in the Climate Change Policy 2020. The climate change policy is based on several mandates and principles in the Constitution of the Kingdom of Bhutan and in compliance with national legislation such as the National Environment Protection Act 2007 and Public Finance Act 2007. The key guiding principles and mandates from the Constitution based on mandates ensuring the wellbeing of the people of Bhutan, consideration of intergenerational equity and following the middle path to development (See Box 1).

The NAP Process in Bhutan is defined in the Climate Change Policy 2020 as "*the procedure and processes related to formulation of the NAP document and its implementation at a later stage*" and is based on the definition from COP decision 5/CP.17. The different aspects of the NAP process for Bhutan are covered in the climate change policy as follows.

- The continuous, progressive, and iterative process of adaptation planning and implementation and the integration of adaptation into development planning is defined in policy statement 2.
- The mandates and institutional arrangements to support and enable a continuous and iterative NAP process, including for collaboration and coordination across sectors and stakeholders are covered in policy statements 3 & 4).

[2] Statements 1, 2, 3, & 4 of Policy Objective 2: Building resilience to climate change.

- The policy also lays the foundation for an M&E system for climate change in section 6, statements 1.7, 1.8, 2,4, 3.1.4, 4.4, section 5.1.
- The roles of stakeholders including private sectors, CSOs is defined throughout the policy.
- The principles of NAP process and cross cutting issues is also mandated by "taking into account opportunities for synergies and cross-cutting issues, including gender equality considerations and disaster risk management".
- Synergies in climate action is mandated in implementation measures (Section 5.4).

PERIODICITY OF NAP

The periodicity of NAP is set at five years as the climate change policy states that, "national priorities for adaptation shall be assessed on the same periodicity as the NDC and undertaken as part of the NAP Process of the UNFCCC". The NAP process in Bhutan is also linked to the Paris Agreement as stated in the climate policy that, "National priorities and needs for adaptation shall be conveyed internationally as an "Adaptation Communication" under the Paris Agreement and developed as part of NAP process". In addition, RGOB has stated in the 1st and 2nd Nationally Determined Contributions (NDC) that the first Adaptation Communication will be conveyed as part of the first NAP.

Box 1: Guiding Principles of Bhutan's Climate Change Policy.

Guiding Principles for Climate Change Policy

The climate change policy is guided by the following principles:

- The principle of state policy "to ensure a good quality of life for the people of Bhutan in a progressive and prosperous country that is committed to peace and amity in the world" as articulated in Article 9.1 of the Constitution of the Kingdom of Bhutan;
- The principle of state policy to "Promote those conditions that will enable the pursuit of Gross National Happiness" as articulated in Article 9.2 of the Constitution of the Kingdom of Bhutan;
- The fundamental rights and duties of each citizen to act as a trustee of the Kingdom's natural resources and environment for the benefit of present and future generations, including the prevention of pollution as articulated in Article 5 of the Constitution of the Kingdom of Bhutan
- The middle path approach in obligations of the Royal Government under Article 5 of the Constitution to conserve the environment for ecologically balanced sustainable development while promoting justifiable economic and sustainable development.
- The recognition of intergenerational equity and provision of a safe and healthy environment and for present and future generations of the people of Bhutan intergenerational equity, as articulated in Articles5.1 and 5.2 of the Constitution of Bhutan
- The precautionary principle as articulated in Chapter II of the National Environment Protection Act 2007 (NEPA 2007) and the "no-regrets" approach to taking beneficial action to safeguard against climate change.
- The polluter pays principle and payment of ecosystem services to pay for use of resources and damages to the environment as elaborated in Chapter II of NEPA 2007
- The right to information and the engagement of all stakeholders as articulated in NEPA 2007.
- Ensure coherent and clear implementation of national climate priorities in line with international obligations.

(From Climate Change Policy of the Kingdom of Bhutan, 2020)

1.3 Institutional Arrangements for Climate Change

The institutional arrangements for climate change action are described in the Climate Change Policy 2020.

Overall coordination and oversight of the climate change policy

a) *National Climate Change Committee*:

The National Environment Commission (NEC) functions as the high-level National Climate Change Committee (NCCC). The NEC chaired by the Hon'ble Prime Minister, or his nominee 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. The NEC derives its mandate from the National Environment Protection Act 2007, Environmental Assessment Act 2000, Waste Prevention and Management Act 2009, Water Act 2011, and other directives of the government. The NEC in its role as the NCCC considers all policy and regulatory matters on climate change.

The NCCC is supported in implementing its mandates and functions through the National Environment Commission Secretariat (NECS). The NEC Secretariat (NECS) in supporting the NEC/NCCC leads the preparation of national strategies and plans on climate change such as NDCs, NAPs, LEDS. As of 30 Dec 2022, the NECS has been reconstituted and renamed as the Department of Environment & Climate Change (DECC) under the Ministry of Energy and Natural Resources (MoENR) and will serve as the Secretariat to the NEC[3].

b) *Climate Change Coordination Committee*:

The Climate Change Coordination Committee (C4) is the technical body to serve 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 Director General of DECC. The committee derives its mandate from the Executive Order of the Prime Minister of October 16, 2016. The C4 is supported in implementing its mandates and functions through the Climate Change Division of DECC. The C4 monitors and provide guidance on the overall implementation of the climate change policy and has a particular mandate to ensure an effective and coordinated implementation of actions on climate change in Bhutan.

Resource mobilization and allocation

c) *Ministry of Finance*:

The Ministry of Finance (MoF) is mandated to formulate and implement dynamic fiscal policies and sound financial management through maximization of resource generation, efficient

[3] Press Release from Royal Civil Service Commission (RCSC/LD-63/2022/2265) dated December 30, 2022

allocation, prudent expenditure and debt management and proper accountability of public resources. The mandates and functions of the MoF is governed by the Public Finance Act, Public Debt Policy, Income Tax Act, Revised Taxes and Levies Act, Fiscal Incentives Act and PPP Policy. In line with provisions of the various legislations, MoF has mandate for resource mobilization and budget allocation and providing fiscal incentives and other instruments to support private sector lending to support implementation of the policy.

The recent reorganization of the Civil Service[4] led to the integration of the Gross National Happiness Commission (GNHC) with the MoF and the Office of the Cabinet Affairs and Strategic Coordination (OCASC). The merger transferred several mandates of the erstwhile GNHC's relevant to climate change support to the MoF as follows; (i) management of external grants is now with the Department of Macro-Fiscal and Development Finance and (ii) responsibilities of central and local government planning is now under the Department of Planning, Budget and Performance. With this change, national mandates for facilitating international climate change support from funds such as the GCF, GEF, LDCF, etc. will now be managed by the MoF.

CLIMATE DATA AND INFORMATION

d) National Center for Hydrology and Meteorology:

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 provide hydro-meteorological data and information, climate modelling and scenarios and other early warning services.

e) Royal University of Bhutan and Research Institutions:

The Royal University of Bhutan (RUB) and other research institutions, in line with their respective mandates, shall conduct needs-based research to support informed decision-making and the planning and implementation of climate change action.

SECTORS AND LINE AGENCIES

f) Other Agencies, Civil Society and Private Sector

The roles and responsibilities of all other sectoral agencies and organisations including civil society and private sector are also defined in an annex to the climate change policy. These organisations are to integrate climate change action within their respective mandates, policies, and programs.

[4] Press Release from Royal Civil Service Commission (No. RCSC/LD-63/2022/1106) dated October 2, 2022.

1.4 National Circumstances

A brief overview of the national circumstances of Bhutan is presented below to provide context for the NAP. A full description of the national circumstances is available in Bhutan's Third National Communication submitted in 2020.

Geography

Bhutan is a small, landlocked country with an area of 38,394 km^2 situated on the southern slope of the Eastern Himalayas. The country is almost entirely mountainous with altitudes ranging from about 100 meters in the foothills to over 7,500 meters in the north (Figure 1). Due to its fragile mountainous ecosystem, Bhutan is highly vulnerable to impacts of climate change and extreme weather events. The situation is further worsened by the country's low adaptive capacity and poor economic status constrained by limited financial, technical, and human capacity. Additionally, the country's economy is still predominantly dependent on climate sensitive sectors like agriculture and hydropower. The mountainous landscape makes communication and transport very fragile and expensive.

Climate

The climate of Bhutan is exceptionally diverse with three distinct climatic zones: subtropical, alpine, and temperate, which encompass numerous micro-climates due to dramatic variations in elevation and topography (NCHM 2019). Two main factors affecting the variation in climatic variation of mean temperature and precipitation are: the vast differences in altitude in the country and the influence of the North Indian monsoons. Bhutan's location at the northern periphery of the tropical circulation is an important feature that determines its climate.

Bhutan receives about 70% of the precipitation during monsoons, while pre-monsoon rainfall accounts for 20%. The annual precipitation ranges widely in various parts of the country. The northern region gets about 40 mm of annual precipitation, mostly in the form of snow. The temperate central valley receives about 1,000 mm of rainfall, while the southern region gets about 1,500 mm of rain annually (NSB, 2018). The monsoons last from late June through late September. (See figures 2, 3, & 4).

Agriculture

The agriculture sector comprises of farming, livestock and forestry which continues to be a major player in the country's economy. With only 2.75% of the total land area used for agriculture (DoFPS, 2016), the sector accounted for 17.37% of GDP in 2017 (NSB, 2018) and employed about 51% of the total population (MoAF 2020 in RNR Strategy 2030)

Figure 1: Bhutan Physical Map[5]

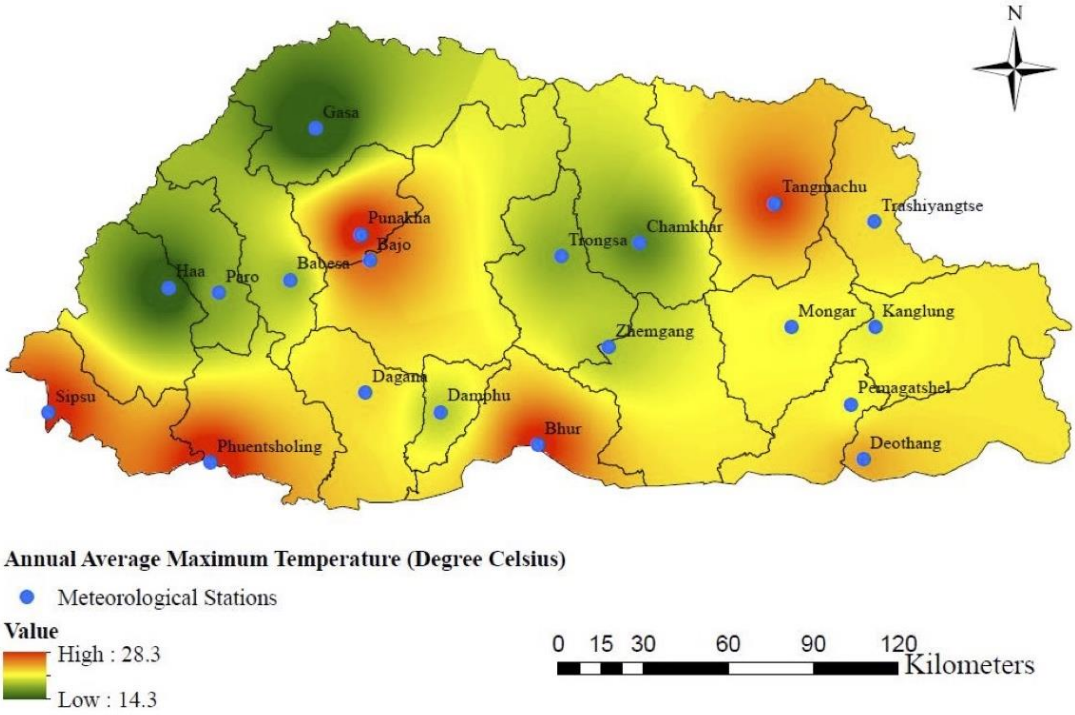


Figure 2: Bhutan climate, average annual maximum temperature in 2020. Source NCHM, Bhutan.

[5] Source: https://gisgeography.com

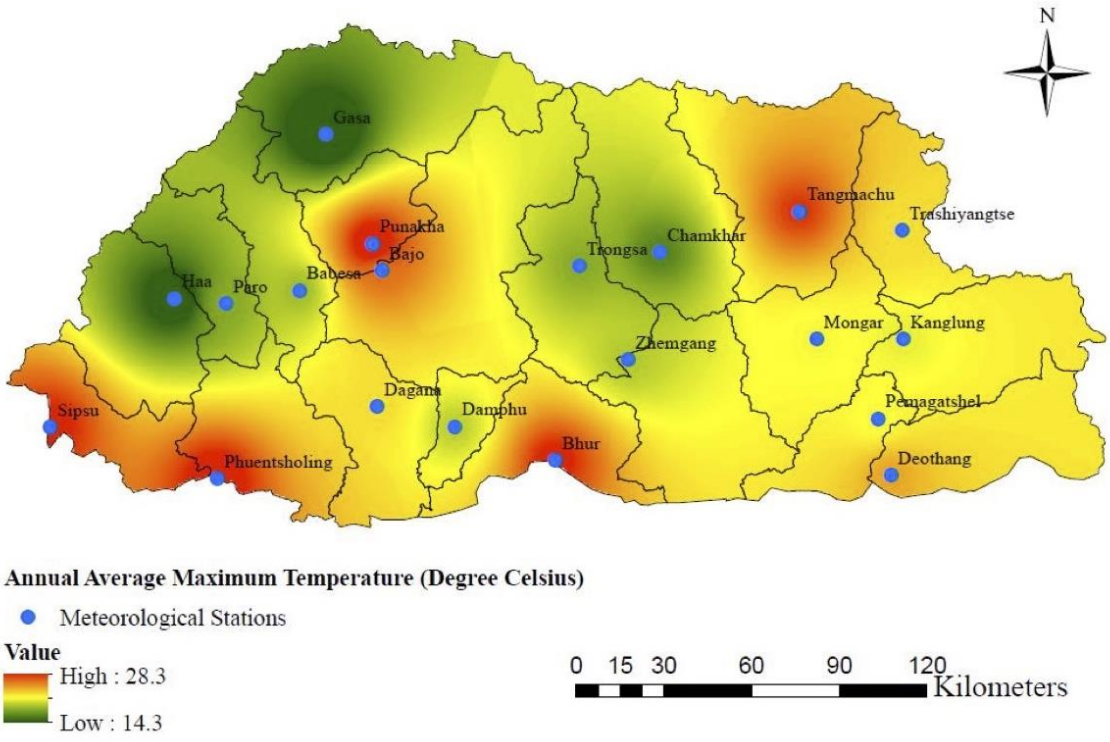


Figure 3: Bhutan climate, average annual minimum temperature in 2020. Source NCHM, Bhutan.

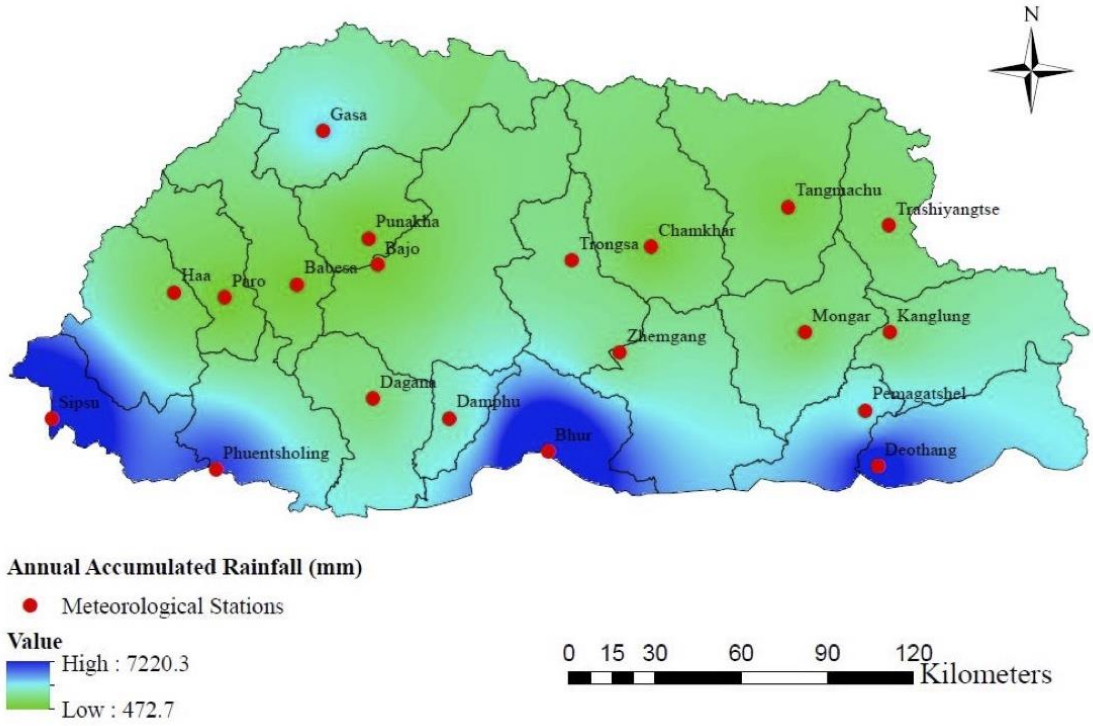


Figure 4: Bhutan climate, annual accumulated rainfall in 2020. Source NCHM, Bhutan.

NATURAL RESOURCES

Forest resources

Bhutan has a total of 70.77 % forest cover (2,717,161.64 ha) out of the total geographical area (3,839,400 ha) of the country (FRMD, 2017). Broadleaved forests constitute around 65% of the forested area, while conifer forests make up about 35%. The forest cover of Bhutan marginally increased from 70.46% in 2010 (LCMP, 2010) to 70.77% in 2016 (FRMD, 2017). The total forest carbon stock of Bhutan is 645 million tonnes of carbon in the form of biomass carbon and soil organic carbon (SOC) (FRMD, 2020). The biomass carbon pool constitutes 457 million tonnes of total carbon stock, and 188 million tonnes of carbon is stored in mineral soils/soil carbon pool (FRMD, 2020).

Protected Area Network

The protected area network of Bhutan consisting of five National Parks, four Wildlife Sanctuaries, one Strict Nature Reserve, eight Biological Corridors and a Royal Botanical Park, covers 51.44% of the country's area. The protected area system in Bhutan is unique in that there are human settlements occurring within the PAs that play an essential role in our conservation efforts, unlike in other parts of the world, where communities in the PAs are relocated (MoAF, 2019).

Biodiversity

Due to the high forest cover located in the eastern Himalayas, pristine environment, strong conservation efforts and good network of Protected Areas, Bhutan has flourishing populations of some of the rarest flora and fauna on earth. The 2017 Biodiversity Statistics of Bhutan records 11,248 species of all biodiversity groups found in Bhutan. Several plants and animal species listed as vulnerable, endangered, or critically endangered by IUCN are also found in Bhutan. (MoAF, 2018).

Water resources

Most of the major rivers in Bhutan originate from glaciers and are recharged by watershed. The river system is generally distinguished by main rivers that flow from north to south, with tributaries flowing in an east-west direction. The main rivers are Amochhu, Wangchhu, Punatsangchhu and Manas. Two large rivers, Mangdechhu and Drangmechhu, converge into one river and make up the Manas just before crossing the Indian border. The Manas River covers about half the country.

Most of the river discharge results from rainfall, supplemented by an estimated 2-12% glacial melt and another 2% from snow melt. The combined outflow of the rivers is about 70,576 million m^3, or 2,238 m^3/s, which corresponds to a flow of 109,000 m^3 per capita per year, the highest in the region.

POPULATION

Bhutan is one of the least populated countries in Asia with a total population of 727,145 in 2017 and Population Growth Rate (PGR) of 1.3% per annum as per Housing and Population Census of Bhutan, 2017 (NSB, 2017). As a result of the gradual increase in the population size, the population density of Bhutan increased from 17 persons per km^2 in 2005 to 19 persons per km^2 in 2017. The distribution of the population over the land area is not uniform throughout the country. While the capital, Thimphu, has the highest population density at 67 persons per km^2, Gasa Dzongkhag has the lowest with just 1.3 persons per km^2.

The 2017 Population and Housing Census of Bhutan (PHCB) reported the literacy rate of 71.4% and the adult (aged 15 years and above) literacy rate of 66.6%. There is a marked difference in the literacy levels between the male and female populations, with 78.1% of the male population literate compared to 63.9% of the female population. Overall, the literacy rate is significantly higher in urban areas (84.1%) than in rural areas (63.6%).

MACROECONOMY

Bhutan is one of the world's smallest economies, with gross domestic product (GDP) in 2017 recorded at Nu. 164.6 billion or approximately USD 2.4 billion per year. However, growth has been remarkable, with the economy growing at an average rate of seven percent per year over the past decade, mainly due to investments in the hydropower sector. GDP per capita increased from USD 2,464 in 2013 to USD 3,438 in 2017.

Bhutan was categorised as a Least Developed Country (LDC) by the United Nations General Assembly (UNGA) in 1971. Over the decades, Bhutan has made remarkable socio-economic advancements, qualifying the country for graduation from this category for the first time at the 2015 triennial review of the list of LDCs.

However, the COVID 19 pandemic led to a shrinkage in economic activities with the economy recording a drastic drop in growth of -10.08 percent in 2020, which is 15.83 percentage points drop as compared to a growth of 5.76 percent in 2019. The key sectors that contributed to the contraction of the economy were Mining & Quarrying at -81.84 percent; Hotel & Restaurants at -73.46 percent; Manufacturing, Construction, and Transport & Communication at -20.76 percent, -20.64 percent, and -14.65 percent respectively. Further, Finance & Insurance; Wholesale & Retail Trade; and Other Business services have also contracted contributing to the overall contraction of the economy in 2020 (NSB 2021).

The public sector has long been the primary source of economic growth, but the government now recognised the significance of private- sector growth. Economic diversification is now a higher priority, and Bhutan has made progress in modernizing its economic structure and reducing poverty. Constraints on private-sector development include an inefficient regulatory framework, significant nontariff barriers to trade, and a rudimentary investment code (The Heritage Foundation, 2019).

Bhutan's economic development policy has been guided by the overarching philosophy of Gross National Happiness (GNH) based on the four pillars of (i) sustainable economic development; (ii) preservation and promotion of culture and tradition; (iii) conservation of the environment; and (iv) good governance. However, sustainable economic growth remains a major challenge as it is financed mainly by external aid (RGoB, 2016).

As a least-developed country with a young growing population, Bhutan has pressing needs for economic development and poverty eradication in a challenging environment while conserving of a globally significant natural environment.

GOVERNANCE STRUCTURE

The government of Bhutan is a democratic constitutional monarchy with the executive power vested in the Cabinet (Lhengye Zhungtshog) headed by the Prime Minister. Bhutan's democratically elected Parliament is the highest legislative institution in the country. It consists of His Majesty the Druk Gyalpo,

the National Council and the National Assembly. The Parliament is bicameral and follows the Westminster Parliamentary system. His Majesty the King is the Head of State. The National Assembly has the legislative, oversight and representational mandates. The National Council has both legislative and review functions and is also referred to as the House of Review on matters affecting the security and sovereignty of the country and the interests of the nation and the people. Under the current parliamentary structure, there are a total of 72 members – 25 members in the National Council and 47 members in the National Assembly elected for a term of five years. (RGOB, 2022).

ADMINISTRATIVE SYSTEM

The administrative system in the country consists of Central Government and Local Government. The Central Government comprises of Ministries, Departments and Autonomous bodies. At the central level, the nine different Ministries are headed by the Cabinet Ministers and at the local level, Bhutan is administratively divided into 20 *Dzongkhags* (districts) (figure 5), each governed by a district administrator or *Dzongda.* The Dzongkhags are sub-divided into small blocks or *gewogs.* There are 205 *gewogs* in the country, grouped under 47 constituencies. The Local Government comprises of Dzongkhag Tshogdu, Gewog Tshogde and the Thromde Tshogde (NSB 2021).

Figure 5: Bhutan: Administrative Map.[6]

[6] Source: https://gisgeography.com

1.5 The NAP Process and Preparation of the NAP

The preparation of the first NAP for Bhutan has been a long process as the national NAP Process was first launched in 2015 but was delayed initially due to lack of financial support and subsequently by the COVID-19 pandemic.

1.5.1 Launch of the NAP Process

The mandate to start preparation of a NAP for Bhutan was launched by the Hon. Prime Minister in March 2015, at the "*Dialogue on Climate Resilient and Carbon Neutral Development"* which also launched the preparation of the Intended Nationally Determined Contribution (INDC) ahead of COP 21. Regarding the NAP process, the high-level workshop recommended that:

a) The NAP process should be long-term, with continuous capacity building and mobilization of support based on national strategy.
b) Adaptation should be addressed at all levels, with more focus to local and community level (on actual implementation).
c) The NEC should take the lead for the NAP.
d) NAPs should be supported under a clear climate policy/mandate.
e) NAPs should contain implementation strategy and timeline.

While awaiting financial support to initiate the NAP process, Bhutan identified priority adaptation needs based on existing policies, plans and strategies and included an adaptation component in the INDC in 2015.

Following the Technical Guidelines to the NAP Process, an initial NAP roadmap was also developed and presented during a national consultative workshop *"Advancing Action on Climate Change for National Priorities and International Obligations*" to sensitise national stakeholders after the adoption of the Paris Agreement. This road map also served to guide the next steps and in engaging key stakeholders for the NAP process.

1.5.2 NAP Readiness Project

Once financial support for NAP preparation was made available through the GCF, the preparation of a NAP readiness proposal was initiated with the support of UNDP/NAP Global Support Program in 2016. The NAP readiness proposal was submitted to the GCF and contained components for enhancing coordination; capacity development to produce climate scenarios; vulnerability assessment; NAP formulation; capacity development for M&E. The NAP readiness project was subsequently approved in January 2019.

1.5.3 Assessments conducted to support of the NAP process

As part of the NAP Readiness Project, several activities were undertaken to facilitate the establishment of the NAP process, and preparation of Bhutan's first NAP. In addition to several capacity building activities for vulnerability assessment and adaptation planning, several assessments and strategic documents were prepared based on the outcome of a stock taking exercise, and a localised version of the NAP Technical Guidelines.

These assessments were undertaken to support and inform the NAP process and preparation of the first NAP from Bhutan. These assessments were prepared with the support of sectoral teams and technical consultants and build on past efforts and actions through a consultative process to ensure inclusivity. The documents are listed below and are available separately on the Bhutan ClimatePlatform[7].

Technical reports strategies and guidelines prepared to support the NAP process

1. Guidelines for National Adaptation Plan (NAP) Formulation Process in Bhutan, NAP Readiness Project, Thimphu 2020
2. Protocol for NAP formulation process in Bhutan, NAP Readiness Project, Thimphu 2020
3. Bhutan Climate Platform, Thimphu. NAP Readiness Project, Thimphu 2022
4. Skills Assessment for NAP Formulation Process in Bhutan, Thimphu , Bhutan, NAP Readiness Project, Thimphu 2020
5. Stakeholder Engagement Plan for National Adaptation Plan (NAP), NAP Readiness Project, Thimphu 2020
6. Stocktaking for Climate Change Vulnerability Analyses and National Adaptation Plan (NAP) Mapping for National Adaptation Plan (NAP) Formulation Process in Bhutan, NAP Readiness Project, Thimphu 2020
7. Skills Assessment for Climate Change Vulnerability Analyses and National Adaptation Plan (NAP) Mapping for National Adaptation Plan (NAP) Formulation Process in Bhutan, NAP Readiness Project, Thimphu 2020
8. SDG Structured Dialogue, NAP Readiness Project, Thimphu 2020
9. A Roadmap and Strategy for Strengthening Climate Change Research in Bhutan 2021 – 2025, NAP Readiness Project, Thimphu 2020
10. Climate Change Vulnerability Analyses and Mapping for NAP Formulation Process in Bhutan, NAP Readiness Project, Thimphu 2022

Climate Risk Assessments

1. Assessment of Climate Risks on Agriculture for NAP Formulation Process in Bhutan, NAP Readiness Project, Thimphu 2022
2. Assessment of Climate Risks on Forests and Biodiversity for NAP Formulation Process in Bhutan, NAP Readiness Project, Thimphu 2022
3. Assessment of Climate Risks on Health for NAP Formulation Process in Bhutan, NAP Readiness Project, Thimphu 2022
4. Assessment of climate risks on Water Resources for the NAP in Bhutan, NAP Readiness Project, Thimphu 2022

1.5.4 Drafting the NAP

This National Adaptation Plan has been prepared by the NAP Drafting Committee (NAP DC) comprising various members of the Thematic Working Groups (TWG) who worked on the Climate Risk Assessment

[7] Visit www.nec.gov.bt for link to the Bhutan Climate Portal

for Agriculture, Forests and Biodiversity, Health, and Water Resources. These four sectors were prioritized for further risk assessment based on the NAP stocktaking exercise. The preparation of the NAP entailed several rounds of consultations with different stakeholder groups. See Annex 2 for the list of consultations.

Technical reviews and consultations

The drafting of the NAP was affected and delayed by the COVID-19 Pandemic and the health restrictions and lockdowns prevented consultations and conclusion of the sectoral climate risk assessments. Several of the consultations and meetings were held in virtual mode throughout the pandemic in 2020 and 2021 but the delays and disruptions significantly delayed the preparation and drafting of the NAP.

The initial round of consultations focused on identifying (i) the adaptation priorities and (ii) enabling activities for the NAP process. This exercise was based on the results of the four climate risk assessments for Agriculture, Forests and Biodiversity, Health, and Water, and build on the adaptation plans and priorities contained in other national climate change strategies and documents such as the INDC and the Third National Communication. These initial consultations were limited within the four sectoral TWGs of Agriculture, Forests and Biodiversity, Health, and Water. Several targeted consultations were also held with stakeholders from the private sector and human settlements sector. Subsequent consultations were conducted among all members of the TWG including representatives from CSOs and the private sector.

Following the consolidation of the adaptation priorities and enabling activities, the Review Team of the NAP Drafting Committee recommended that while the four priority sectors (agriculture, health, forests & biodiversity, and water) covered priorities from most other sectors the priority actions and activities needed to be reorganised under an expanded list of sectors for better visibility and focus for subsequent implementation. The final sectors for the adaptation priorities included in Chapter 3 was expanded to seven sectors: (i) Water (ii) Agriculture and Livestock (iii) Forests and Biodiversity (iv) Human Settlements and Climate Smart Cities (v) Health (vi) Energy (vii) Climate Services and Disaster Risk Reduction. Further targeted consultations with the private sector and CSOs were also held to ensure inclusion of all stakeholder groups.

Regional and national level consultations

Subsequent consultations and work of the NAP Drafting Committee focussed on approaches for the Implementation Strategy and Monitoring and Evaluation of the NAP. After the first draft of the NAP was completed based on the technical assessments, subsequent consultations were expanded to a wider range of stakeholders in October 2022. Consultations on the draft NAP and priorities were held over four regional level consultations with district level planners, sector heads and chairs of local governments in Bumthang, Trashigang, Gelephu and Punakha. A final national level consultation was conducted with heads of national agencies, and representatives of CSOs, private sector and development partners in Thimphu.

There was unanimous endorsement of the approach and priorities in the first NAP at the consultations. Almost all concerns about various risks in different regions or sectors raised at the consultations were found to be captured in the adaptation priorities and enabling activities prepared by the NAP drafting committee as detailed in Chapter 3 and the Annex with detailed tables of priorities.

Local level planners, implementers and stakeholders found that they could refer to the NAP when developing local or sectoral development plans. However, there were concerns on how they could effectively integrate the climate change risks and priorities into their plans. To ensure success in this key step of integrating adaptation into local and national development plans, numerous suggestions were presented including the need for enhancing mainstreaming support, capacity building, resources, information, and approaches. These messages are presented in Box 2.

Final review and endorsement of the NAP

Following the wide consultations, the revised NAP draft was shared to the Climate Change Coordination Committee (C4) and presented to the National Environment Commission. It was endorsed by NEC in its capacity as the National Climate Change Committee.

Box 2: Key messages from regional and national consultations on the NAP

Key messages from regional and national consultations on the NAP

A summary of the points from the regional and national consultations on the NAP is included in Annex 3. The key messages from the consultations are presented below.

Planning and implementation:

- Successful adaptation requires collaboration in bottom-up and top-down approaches. For successful integration of adaptation in development planning in Bhutan, the Mainstream Reference Group (MRG) needs to be revived at national and local levels.
- Systems thinking and a coherent and coordinated approach is required for cost-effective, and efficient implementation of adaptation and development priorities.
- Maladaptation can be avoided through collaboration, coordination, and integrated approaches and awareness.
- In addition to addressing adverse impacts of climate change, take advantage of any positive benefits from climate change to improve livelihoods and resilience.
- Research at the local level in priority areas such as water resources and ecosystems are essential to make informed decisions and adaptation plans.

Implementation approaches and synergies

- Ecosystem- based approaches is essential for adapting to climate change impacts on water resources. Ecosystem- based approaches also means ensuring minimal environmental impact from adaptation interventions.
- Infrastructure development and resilient human settlements should use ecosystem-based approaches and "green infrastructure" to ensure synergistic benefits for liveable and resilient human settlements.
- Disaster risk management and early warning systems are essential and should be a priority as climate induced -hazards are becoming more frequent.

Implementation/financing

- Clear guidance and information on climate financing including availability and allocation is required for successful integration and mainstreaming of adaptation or mitigation.
- Diversification and innovative sources of financing at national to local levels as well as in financial services and private sector can enhance climate resilience and financing.

Key stakeholders, their strengths and capacity needs

- There is need for greater awareness and capacity building for climate change and integration with development at local level.
- It is important to identify and engage appropriately with key stakeholders based on their roles, knowledge, experience, and capacity. Key stakeholders can include the right technical experts, community elders and leaders, the private sector and civil society.
- Education, awareness, and advocacy is a continuous process and should reach out to as many individuals as possible in society and the outreach should start early and with the right information.

Monitoring and evaluation

- A robust Monitoring and Evaluation of adaptation is essential to ensure effective implementation of the NAP, and to avoid maladaptation.

2. IMPACTS RISKS AND VULNERABILITIES

2.1 SUMMARY OF OBSERVED AND PROJECTED CLIMATE

The overview of observed and projected climate for Bhutan is extracted from the Chapter on Vulnerability and Adaptation Assessment of the Third National Communication (TNC) from Bhutan to the UNFCCC 2020, which is also largely based on projections in the National Center for Hydrology and Meteorology (NCHM) publication ''Analysis of Historical Climate and Climate Projection for Bhutan, 2019". A summary is presented below and the two reference documents can be accessed for in depth review of climate projections over Bhutan.

Bhutan lacks extensive and long-term historical temperature and rainfall data sets and observed data is available only from 1996. As an alternative, temperature, and rainfall data from Climatic Research Unit (CRU), University of East Anglia, the United Kingdom was used as proxy data and validated against the available observed data from the 15 climate stations in Bhutan.

Climate projections for Bhutan was assessed for two future periods: a short-term period (2021-2050) and a long-term period (2070-2099) and considered two socio-economic scenario representing trends – Representative Concentration Pathways (RCP) of high emission (RCP 8.5) and intermediate emission (RCP 4.5) of the IPCC fifth assessment report (2014). There is no projection for a medium-term period (2051-2069).

2.1.1 HISTORICAL TRENDS

Historical Trends in Temperature (1976 – 2005)

NCHM's analysis of trends in climate parameters using CRU data for Bhutan from 1976 to 2005 showed an increasing trend in temperature (Figure 6). Mean annual temperature increased by 0.8 degrees Celsius and seasonal temperature has increased as well, with the highest increase during the winter season by 1.3 degrees. The spatial variation in temperature over the country and over the seasons is illustrated in figure 7. In general, temperatures are cooler in the norther highlands and is warmer in the southern regions at lower elevations. The seasons and corresponding months are defined in Table 1.

Historical Trends in Mean and Seasonal Rainfall (1976 – 2005)

There was a decreasing trend in rainfall at mean annual scales with high variability (Figure 8). Seasonal rainfall in Bhutan is characterised with a wet summer monsoon (JJAS) and dry winter season (DJF). Figure 9 shows the spatial variation of mean annual and seasonal rainfall across Bhutan. Rainfall amounts are highest for the summer season (JJAS) while the other seasons are relatively dry. The spatial variation between the regions can also be observed with much higher rainfall in the country's southern belt.

Table 1: Seasons and corresponding months in for Bhutan based on NCHM clusters

Season	Months	Abbreviation
Winter	December, January, February	DJF
Spring	March, April, May	MAM
Summer	June, July, August, September	JJAS
Autumn	October, November	ON

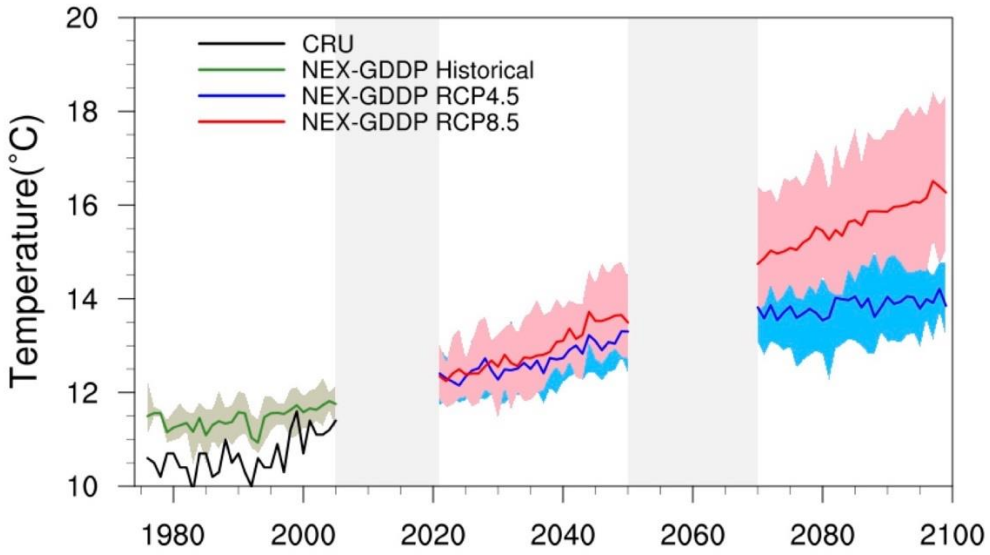


Figure 6: Historical trends and projections of mean annual temperature over Bhutan. (Source, NCHM 2019)

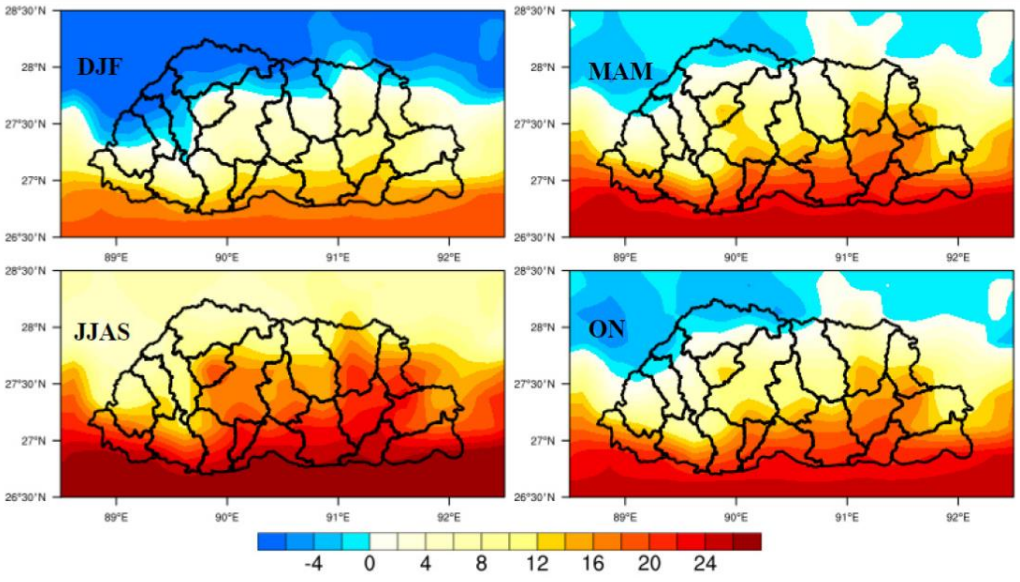


Figure 7: Spatial distribution of seasonal mean temperature (°C) over Bhutan for the period 1976-2005 (Source: NCHM, 2019)

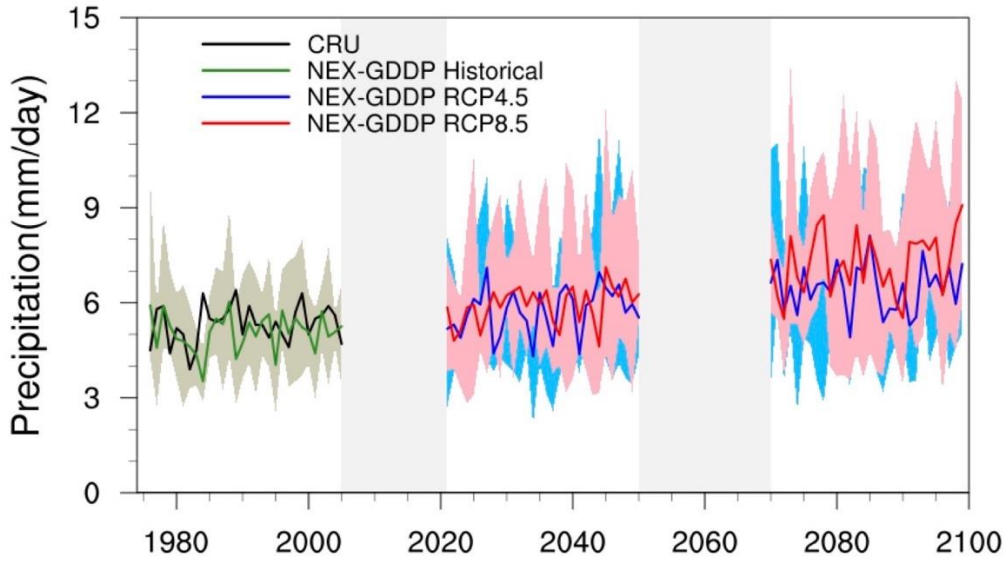


Figure 8: Historical trends and projections of mean annual rainfall over Bhutan. (Source, NCHM 2019)

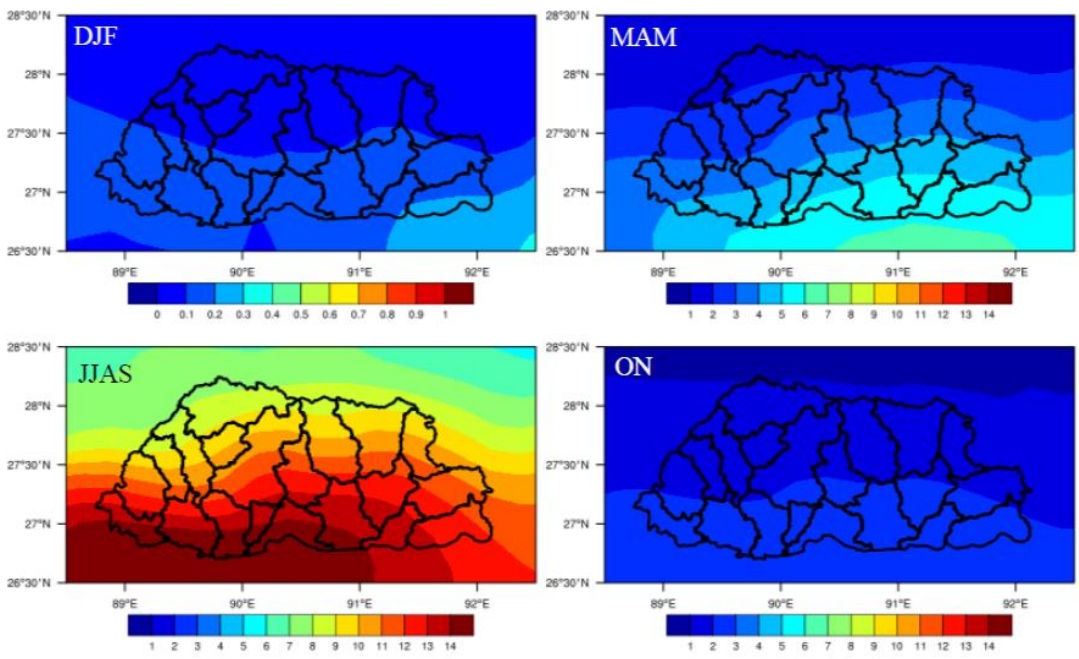


Figure 9: Spatial distribution of seasonal mean rainfall, DJF (Winter), MAM (Spring), JJAS (summer) and ON (Autumn) (Source: NCHM, 2019)

2.1.2 CLIMATE SCENARIOS

Scenarios for Annual and Seasonal Temperature (2021-2100)

NCHM used an ensemble of five model data from NASA Earth Exchange Global Daily Downscaled Projections (NASA GEX-GDDP) for the projection of temperature and rainfall parameters. Projections for temperature and rainfall is for two socio-economic scenarios of RCP 4.5 and RCP 8.5.

The projections show a consistent increase in temperature over the country under both RCPs. Under RCP 4.5 the increase in annual mean temperature is about 0.8°C – 1.6°C all over Bhutan between 2021-2050 with higher increases of 1.6°C – 2.8°C during 2070 – 2099 Figure 10). Seasonal changes during 2021-2050 show increase in the range of 0.9°C – 1.8°C all over Bhutan (Figure 11) and about 1.8°C – 2.8°C by the end of the century (Figure 12). Larger warming is indicated during spring (MAM) and winter (DJF) seasons. The country as a whole is expected to experience an increase in temperature with a larger increase projected in the high lands.

Under RCP 8.5 scenario, an increase in annual mean temperature of 0.8°C – 2.0°C is expected all over Bhutan between 2021-2050 with increases of more than more than 2.8°C towards the end of the century (2070-2099) (Figure 13). Seasonal changes until 2050 under RCP 8.5 are similar to that of RCP 4.5 all over Bhutan (Figure 14). However, more pronounced changes can be noted towards the end of the century in the range of 3.2°C – 5.6°C (Figure 15).

Scenarios for Annual and Seasonal Rainfall (2021-2100)

The mean annual rainfall over Bhutan is likely to increase in the future under both the RCPs. Under the RCP 4.5 scenario, the yearly rainfall in Bhutan could increase with about 10% to 30% increase in the summer (JJAS). The projection also notes a likely increase of rainfall during the winter (DJF) with some parts in the north and northwest likely to experience a decrease in rainfall. The annual and seasonal changes in rainfall under RCP 4.5 are shown in figures 16, 17 and 18.

Under the RCP 8.5 scenario, the mean annual rainfall indicates an increase of about 10-20% in the short-term period and more than 30% increase all over Bhutan towards the end of the century. While the projections suggest increasing rainfall during the summer season (JJAS), the north-western region of the country is expected to experience a decrease in rainfall in winter (DJF). The annual and seasonal precipitation changes under RCP 8.5 are shown in figures 19, 20, & 21.

Changes in temperature under RCP 4.5 (Figures 10-12)

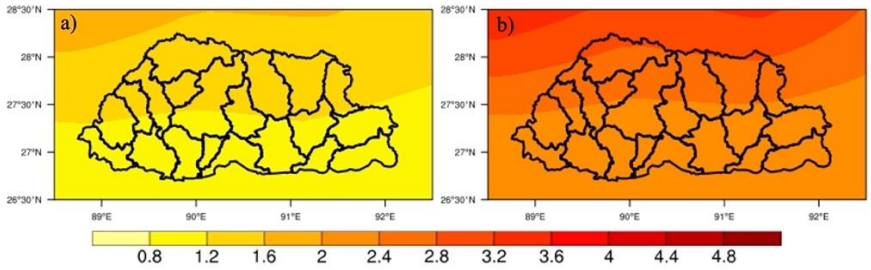


Figure 10: Projected Annual Mean temperature under RCP 4.5 scenario. *Panel (a) shows difference in annual mean temperature (°C) between 2020-2050 and present-day climate. Panel (b) shows difference in annual mean temperature (°C) between 2070-2099 and present-day climate.* (Source: NCHM 2019)

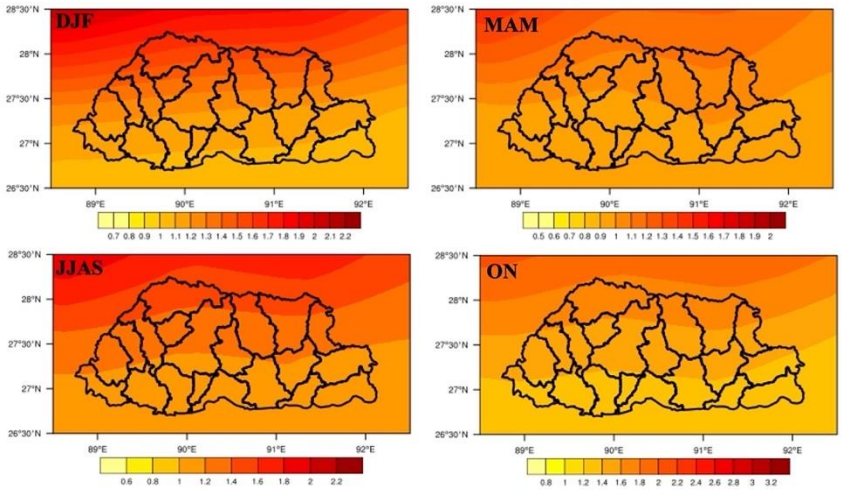


Figure 11: Difference in seasonal mean temperature (°C) between future (2021-2050) and present-day climate under RCP 4.5 scenario. (Source: NCHM, 2019)

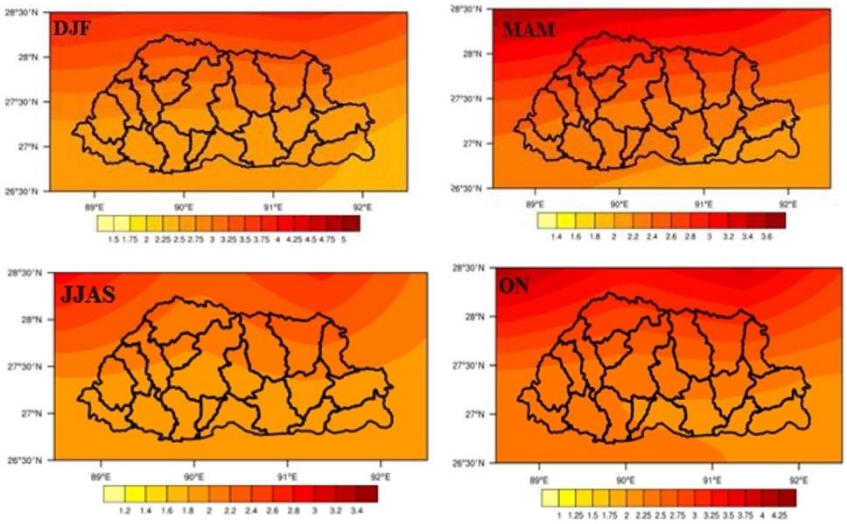


Figure 12: Difference in seasonal mean temperature (°C) between future (2070-2099) and present-day climate under RCP 4.5 scenario. (Source: NCHM, 2019)

Changes in temperature under RCP 8.5 (Figures 13-15)

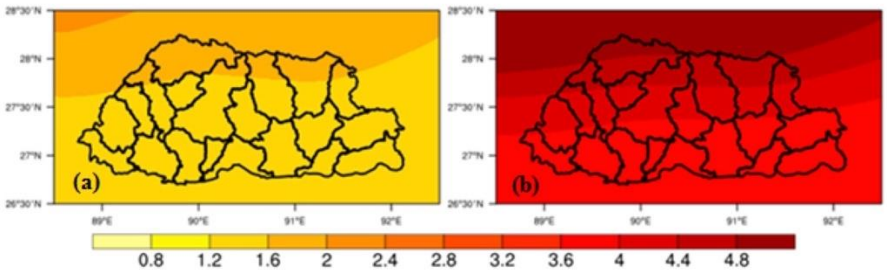


Figure 13: Projected Annual Mean temperature under RCP 8.5 scenario. *Panel (a) shows difference in annual mean temperature (°C) between 2020-2050 and present-day climate. Panel (b) shows difference in annual mean temperature (°C) between 2070-2099 and present-day.* (Source: NCHM, 2019)

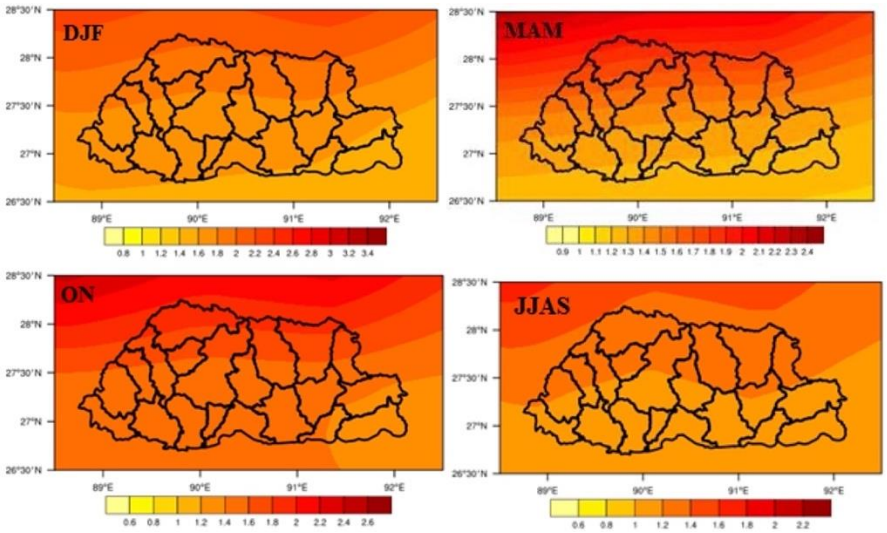


Figure 14: Difference in seasonal mean temperature (°C) between future (2021-2050) and present-day climate under RCP 8.5 scenario. (Source: NCHM, 2019)

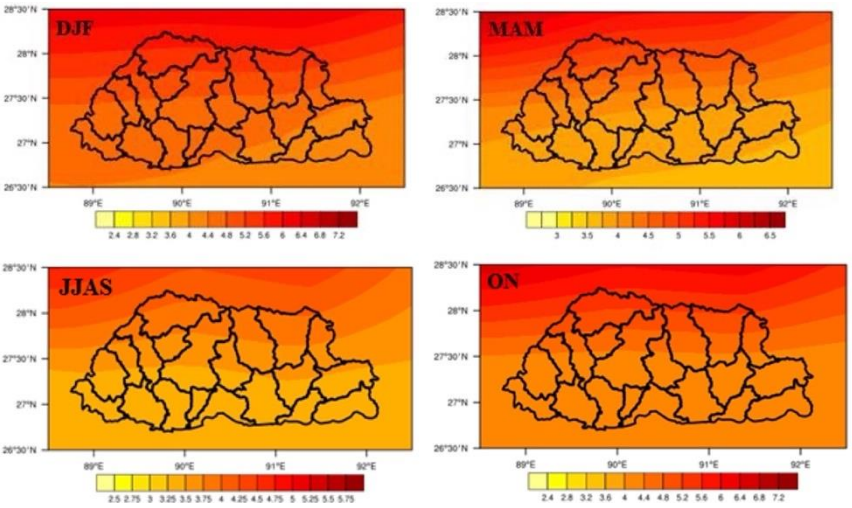


Figure 15: Difference in seasonal mean temperature (°C) between future (2070-2099) and present-day climate under RCP 8.5 scenario. (Source: NCHM, 2019)

Changes in precipitation under RCP 4.5 (Figures 16-18)

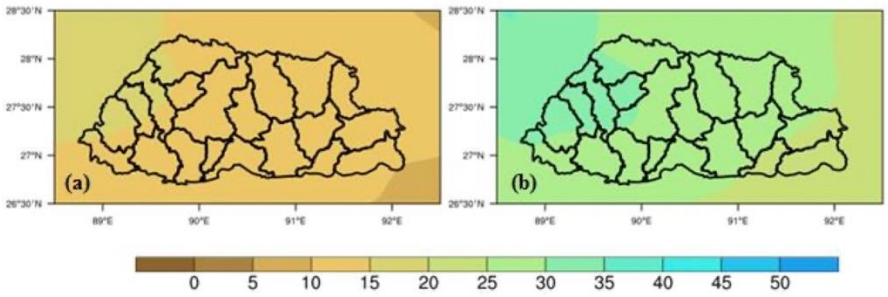


Figure 16: Change in annual mean precipitation under RCP 4.5 scenario. *Panel (a) shows difference in annual mean precipitation between 2020-2050 and present-day climate and panel (b) shows difference in annual mean precipitation between 2070-2099 and present-day climate.* (Source: NCHM 2019)

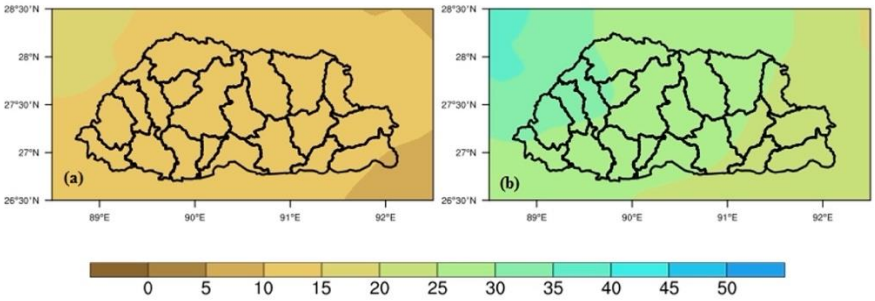


Figure 17: Change in summer (JJAS) precipitation under RCP 4.5 between future and present-day climates. *Panel (a) shows difference with 2021-2050 and panel (b) shows difference between now and 2070-2099.* (Source: NCHM, 2019)

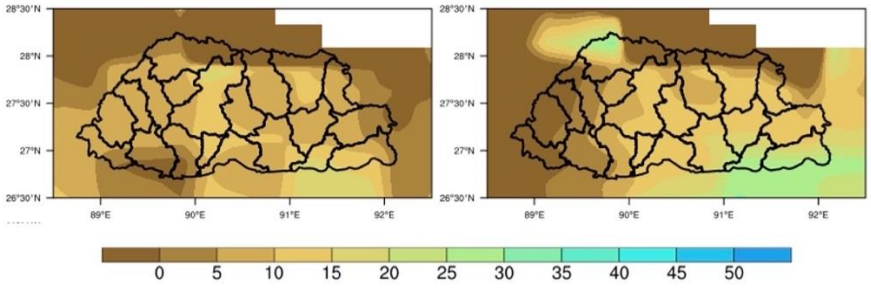


Figure 18: Change in winter (DJF) precipitation under RCP 4.5 between future and present-day climates. *Panel (a) shows difference with 2021-2050 and panel (b) shows difference between now and 2070-2099.* (Source: NCHM, 2019)

Changes in precipitation under RCP 8.5 (Figures 19-21)

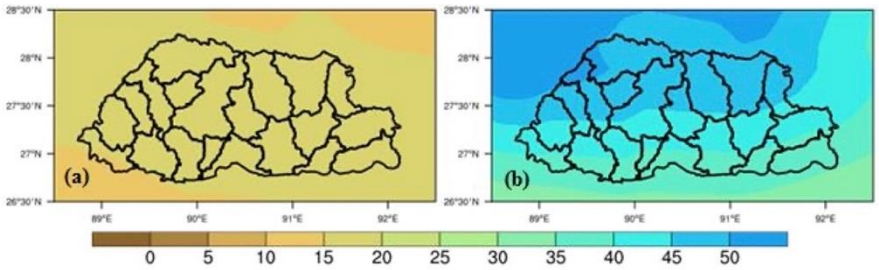


Figure 19: Change in annual mean precipitation under RCP 8.5 scenario. *Panel (a) shows difference in annual mean precipitation between 2020-2050 and present-day climate and panel (b) shows difference in annual mean precipitation between 2070-2099 and present-day.* (Source: NCHM, 2019)

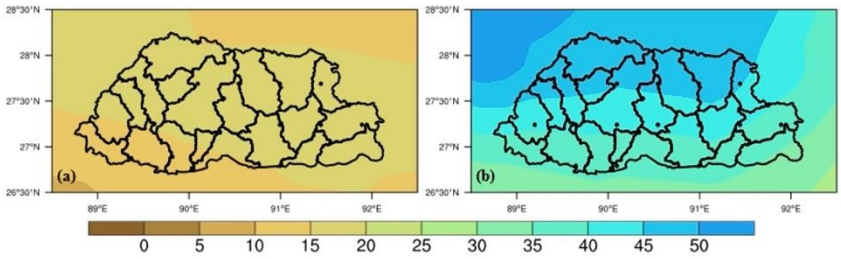


Figure 20: Change in summer (JJAS) precipitation under RCP 8.5 between future and present-day climates. *Panel (a) shows difference with 2021-2050 and panel (b) shows difference between now and 2070-2099.* (Source: NCHM, 2019)

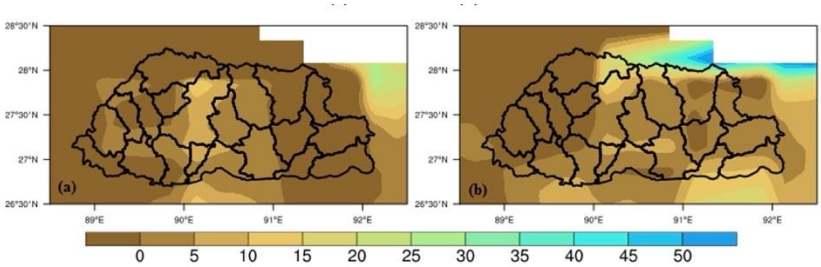


Figure 21: Change in winter (DJF) precipitation under RCP 4.5 between future and present-day climates. *Panel (a) shows difference with 2021-2050 and panel (b) shows difference between now and 2070-2099.* (Source: NCHM, 2019)

Climate Scenarios: Temperature and Rainfall change by elevation (2021-2100)

An Asian Development Bank supported study for NEC in 2016 developed climate projection by elevation, considering the effect of the country's diverse topography. This study broadly divides the country into three climatic zones along the north-south direction, based on the elevation presented in the table 2 below:

Table 2: Climatic zones for Bhutan (NEC/ADB 2016)

Region	Climate	Elevation (m)
Southern foothills	**Subtropical, high humidity, heavy rainfall**	**100 -1,500**
Inner Himalayas	**Cool winters, hot summers, moderate rainfall**	**1,500 - 3,000**
Higher Himalayas	**Alpine, cool summers, cold winters**	**3,000 - 7,550**

Temperature and Rainfall change for Higher Himalayas (2021-2100)
For the Higher Himalayas, temperature is projected increase by 2 degrees under RCP 4.5 and by more than 3 degrees under RCP 8.5. The warming is projected to be higher during the winter months. See Figure 22.

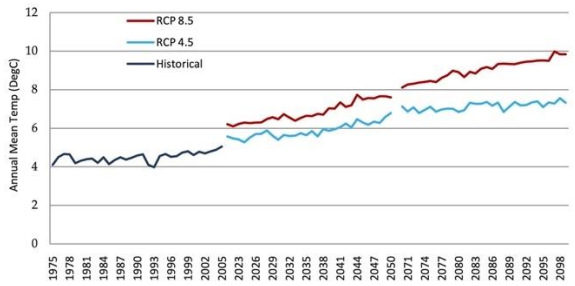
While there is a marginal increase in rainfall under both RCPs for this zone, the model also projects a decrease in rainfall in certain regions. In terms of the monthly average rainfall, the Higher Himalayas is expected to receive higher rainfall during the summer and have a drier winter. See Figure 23.

Temperature and Rainfall change for Inner Himalayas (2021-2100)
For the Inner Himalayas, there is consistent warming under both the RCPs. However, warming is projected to be higher during the winter months. See Figure 24.

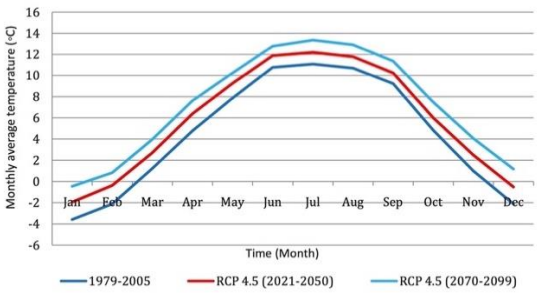
For this elevation zone, the rainfall projection shows an increasing trend under both the RCPs. The seasonal and monthly projection shows drier winter and wetter summer under both the RCPs. However, it is projected that rainfall will increase during winter season under RCP 4.5 in the long term. See Figure 25.

Temperature and Rainfall change for Southern Foothills (2021-2100)
In the Southern Foothills, increase in temperature is consistent with the elevation zones in both the RCPs with a higher warming projected for the winter months. See Figure 26.

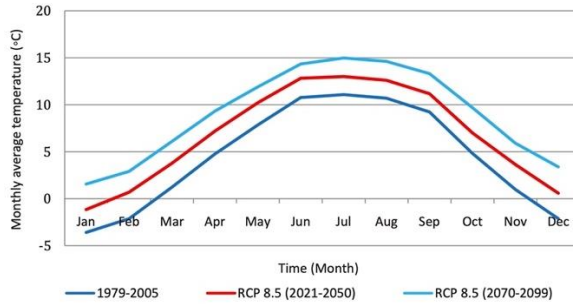
The rainfall projection for this elevation zone shows an increasing trend of rainfall under both the RCPs. The winter season is projected to get drier and wet summer under both the RCPs. However, just as in the Inner Himalayan zone, the rainfall is projected to increase even during winter months under RCP4.5 for 2070-2099 periods. Nonetheless, it is not as clearly visible as the increase in summer precipitation in the graph. See Figure 27.



(a) Changes in mean annual temperature under RCP 4.5 and RCP 8.5 (Higher Himalayas)

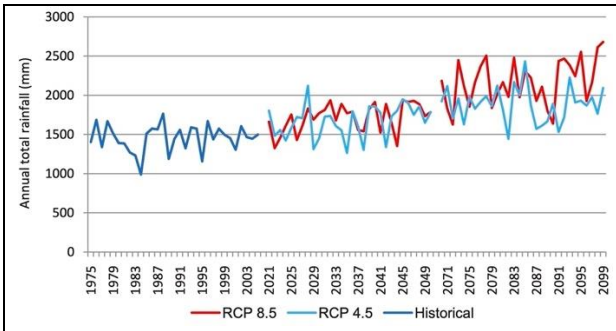


(b) Monthly average temperature changes under RCP 4.5 (Higher Himalayas)

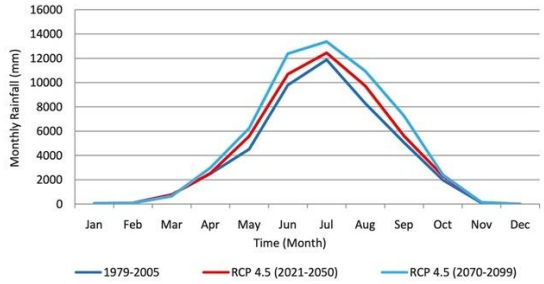


(c) Monthly average temperature changes under RCP 8.5 (Higher Himalayas)

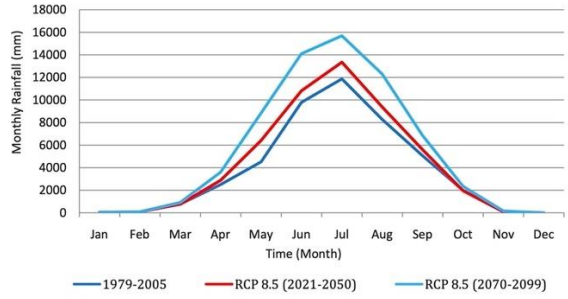
Figure 22: Projections of mean annual and monthly temperature change over the Higher Himalayas for RCP 4.5 and RCP 8.5 during mid to the end of the century (Source: NEC/ADB 2016)



(a) Changes in mean annual rainfall under RCP 4.5 and RCP 8.5 (Higher Himalayas)

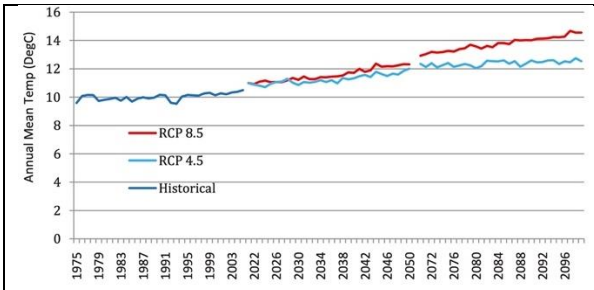


(b) Changes in monthly average rainfall under RCP 4.5 (Higher Himalayas)

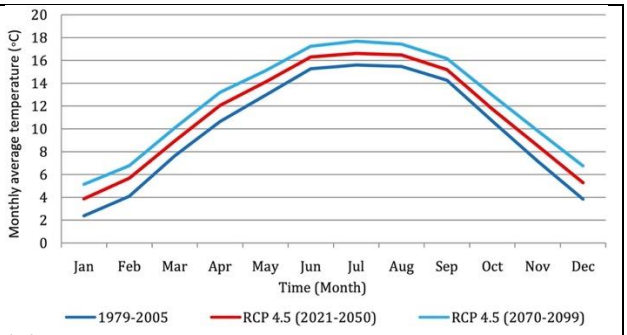


(c) Changes in monthly average rainfall changes under RCP 8.5 (Higher Himalayas)

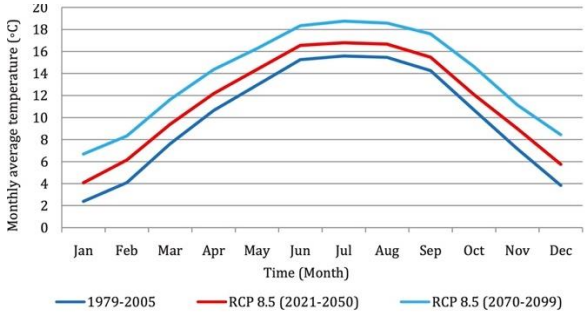
Figure 23: Projections of mean annual and monthly rainfall change over the Higher Himalayas for RCP 4.5 and RCP 8.5 during mid to the end of the century. (Source: NEC/ADB 2016)



(a) Changes in mean annual temperature under RCP 4.5 and RCP 8.5 (Inner Himalayas)

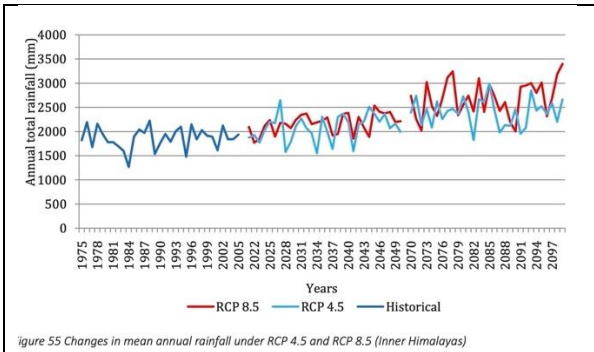


(b) Changes in monthly average temperature under RCP 4.5 (Inner Himalayas)



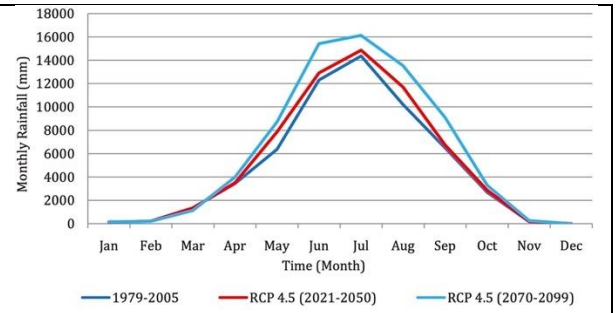
(c) Changes in monthly average temperature under RCP 8.5 (Inner Himalayas)

Figure 24: Projections of mean annual and monthly temperature change over the Inner Himalayas for RCP 4.5 and RCP 8.5 during mid to the end of the century (Source: NEC/ADB 2016)

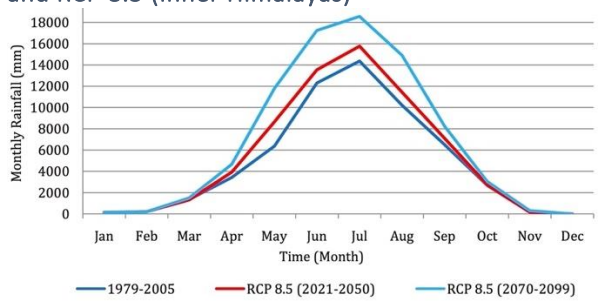


igure 55 Changes in mean annual rainfall under RCP 4.5 and RCP 8.5 (Inner Himalayas)

(a) Changes in mean annual rainfall under RCP 4.5 and RCP 8.5 (Inner Himalayas)

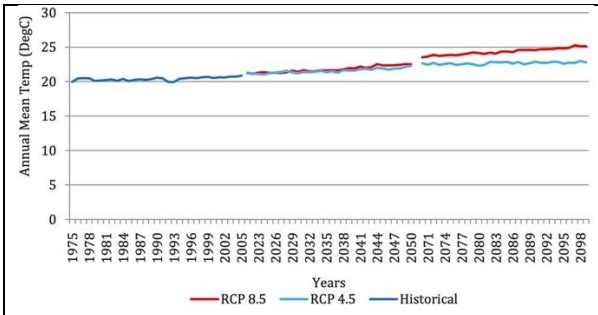


(b) Changes in monthly average rainfall under RCP 4.5 (Inner Himalayas)

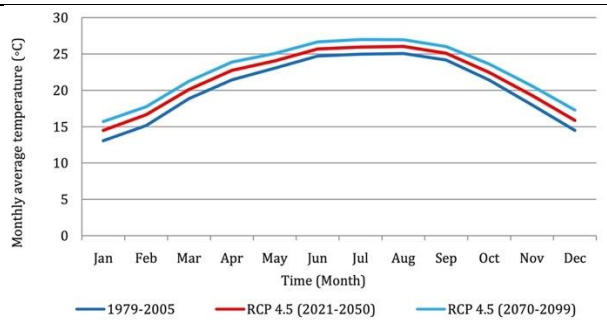


(c) Changes in monthly average rainfall changes under RCP 8.5 (Inner Himalayas)

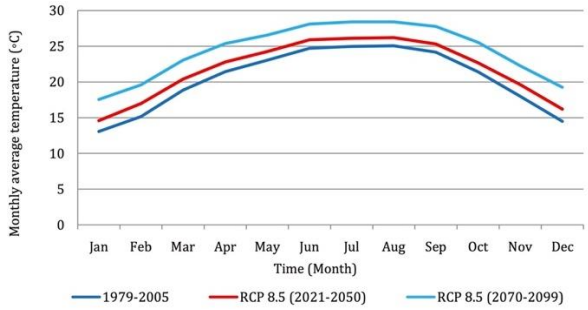
Figure 25: Projections of mean annual and monthly rainfall change over the Inner Himalayas for RCP 4.5 and RCP 8.5 during mid to the end of the century. (Source: NEC/ADB 2016)



(a) Changes in mean annual temperature under RCP 4.5 and RCP 8.5 (Southern Foothills)

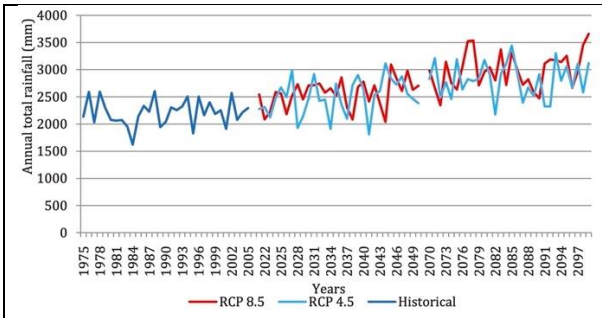


(b) Changes in monthly average temperature under RCP 4.5 (Southern Foothills)

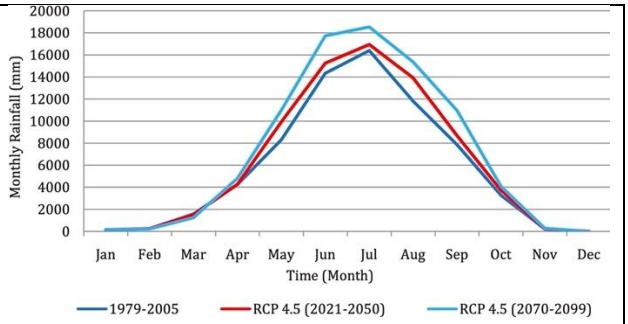


(c) Changes in monthly average temperature under RCP 8.5 (Southern Foothills)

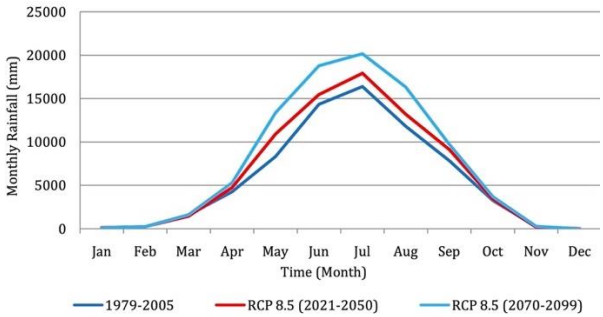
Figure 26: Projections of mean annual and monthly temperature change over the Southern Foothills for RCP 4.5 and RCP 8.5 during mid to the end of the century (Source: NEC/ADB 2016)



(a) Changes in mean annual rainfall under RCP 4.5 and RCP 8.5 (Southern Foothills)



(b) Changes in monthly average rainfall under RCP 4.5 (Southern Foothills)



(c) Changes in monthly average rainfall changes under RCP 8.5 (Southern Foothills)

Figure 27: Projections of mean annual and monthly rainfall change over the Southern Foothills for RCP 4.5 and RCP 8.5 during mid to the end of the century. (Source: NEC/ADB 2016)

2.2 Climate Risk Assessments

Climate risks for Bhutan have been assessed in general terms in the TNC 2020 across five sectors of water, agriculture, forests and biodiversity, energy, and human health. The key climate risks in these sectors are broadly summarised in table 3 below. Further details about risks in these five sectors along with the adaptation options can be viewed in the TNC document.

In addition, climate risk assessments (CRA) for sectors were undertaken as part of the NAP preparation process. In depth technical assessments and intensive consultative discussions were undertaken in preparing the CRAs for water, forests, agriculture, human health. In addition, a fifth study undertook a climate change vulnerability assessment and mapping to assess vulnerability and adaptive capacity across the different administrative regions in Bhutan.

The five different technical assessments that were undertaken to support the NAP preparation are published separately and are considered technical references to support this main NAP document. These five assessments reports[8] and are as follows:

- Assessment of Climate Risks on Agriculture for NAP Formulation Process in Bhutan 2021
- Assessment of Climate Risks on Forests and Biodiversity for NAP Formulation Process in Bhutan 2021
- Assessment of Climate Risks on Health for NAP Formulation Process in Bhutan 2021
- Assessment of climate risks on Water Resources for the NAP in Bhutan 2021
- Climate Change Vulnerability Analyses and Mapping for NAP Formulation Process in Bhutan 2021

While other key sectors such as energy and human settlements and the needs for climate observation and disaster management were not directly assessed they were covered to a certain degree as part of the climate risk assessment for the water sector. The adaptation priorities recommended in these five reports were reviewed and discussed by the NAP drafting committee and the thematic working groups and eventually finalised into the adaptation priorities and enabling activities presented in Chapter 3 on Adaptation Priorities, Needs and Enabling Activities and further detailed in Part II of this NAP document. A summary of findings on climate risks from these assessments are presented in the following sections.

[8] Visit www.nec.gov.bt to download the Third National Communication and the five climate risk assessments to support the NAP formulation process in Bhutan.

Table 3: Summary of climate risks across sectors in the Third National Communication 2020

Water	Agriculture	Forests and biodiversity	Energy	Human health
• Increased disaster risks, • Limited access to water resources and seasonal water shortages.	• Climate change-induced water shortages, • Wildlife predation of crops, • Pests and diseases, • Poor mountainous shallow soils, worsened by increasing soil loss through surface erosion and scarcity of farm labour	• Potential shifts in forest structure and distribution • Damages by pests and diseases on the forest. • Forest fire may reverse carbon sink • New invasive and alien species	• High dependence on hydropower • Hydropower sector adversely affected by water availability and extreme events	• Climate change impacts on determinants of health • Changes in pattern of vector- borne, airborne, and water-borne diseases. • Increased stress on emergency medical health services

2.2.1 Assessment of climate risks on water resources for the National Adaptation Plan (NAP) in Bhutan

The assessment of climate risk on water resources was conducted through a climate risk characterization and impact assessment approach developed by combining bottom-up regional consultations and the top-down model-based analysis. Disaster risk was conceptualized based on the earlier definitions by the Intergovernmental Panel on Climate Change (IPCC, 2012) and The United Nations Office for Disaster Risk Reduction UNDRR (2016). Disaster risk is expressed through three concepts, namely hazard, vulnerability, and exposure. For the top-down analysis, a four-step risk characterization process was followed by first identifying the main types of water-related problems or disasters to focus on; second, defining the main hazard, exposure, and vulnerability indicators for each type of problem; third, carrying out a model-based analysis to quantify hazards at the gewog and sub-catchment level, and finally summarizing the findings on risk through series of hazard maps and risk tables. The results from the bottom-up regional consultations were integrated and evaluated together with the top-down hazard assessment results in the final step.

Current risks and hazards

Consultations with all Dzongkhags and four major Thromdes show that climate related hazards such as drying of sources, floods and landslides are regularly happening and perceived to be increasing.

Historical trends in temperature, rainfall and river flows confirm these perceptions only partly and with high uncertainty. It remains unclear to what extent perceived changes are due to climate change in comparison to anthropogenic pressures such as increased water demand, infrastructure, and land use management.

The top-down quantitative assessment of potential future changes in dry spells, floods, landslides and GLOFs (based on climate projections of temperature, rainfall, and river flows) under climate change indicated that under climate change total annual precipitation is increasing while the underlying patterns of rainfall become more erratic. Temperature is clearly rising especially at higher altitudes. All together this leads to increasing risks of floods and landslides (medium-high confidence) throughout the whole country and potential increase of the duration and frequency of dry spells (medium confidence) in large parts of the country. Also, an increasing risk for GLOFs is likely.

Despite uncertainty in climate change projections and hydrological analysis, results agree with other sources and offer a clear perspective for action. It is evident that disaster risk management in Bhutan (including prevention measures) needs full attention to be ready to cope with more frequent and intense rainfall events. The resilience and robustness of water sources and supply for drinking and irrigation water needs to be improved to support economic growth and improved living standards and cope with climate change at the same time. The hydropower sector will need to better enable its existing and new facilities to cope with more erratic river flow patterns.

Future risks and hazards for water

Risks of local dry spells at Gewog level are expected to increase under climate change for large parts in the country (see Figure 28 & 29) enhancing the drying of sources that are already clearly visible to date. This will increase the challenge to keep up to speed in supplying the growing water demand for drinking, industrial and irrigation water.

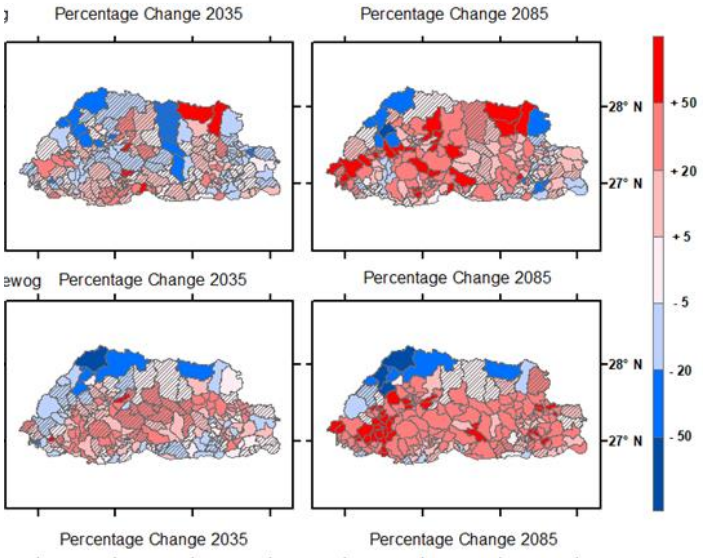


Figure 28: Expected relative change (%) at Gewog level in dry spell duration (upper) and frequency (lower panels) under climate change (RCP4.5) compared to historic climate

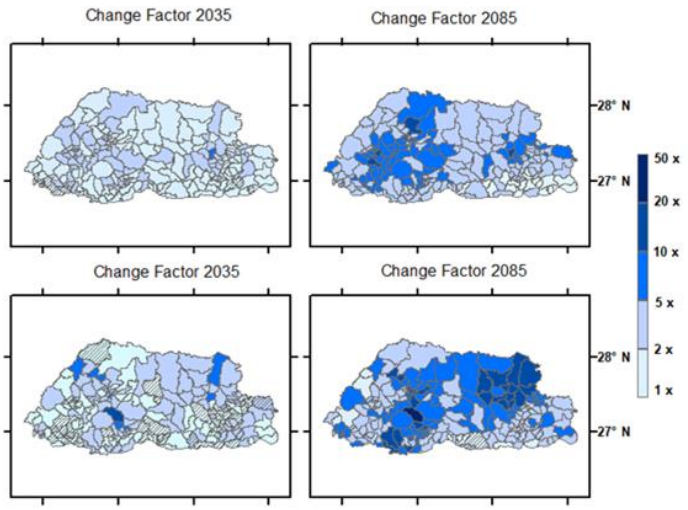


Figure 29: Expected relative change (factor) at gewog level in extreme daily precipitation for the 1/10 year return period (upper) and 1/30 year return period (lower panels) under climate change (RCP4.5) compared to historic climate

Increase of frequency and duration of low flows in main rivers is assessed as an uncertain risk for Bhutan, as projections of periods of low flows both show decrease and increases in dry spells. For RCP4.5 (current emission trajectory) periods of low flows for the short term (2035) are decreasing than increasing. For the long term (2085) the opposite is true.

The risks of increased floods, both pluvial and riverine are assessed as quite high. There are already many serious reports on flash floods and at the same times the projected changes especially for the second half of the century are substantial.

Rainfall events, potentially triggering landslides, is highly likely to increase especially for the longer term. There are already many serious impacts of landslides occurring in the present and recent years.

The melting of glaciers is already occurring under current warming and will continue to occur in the future under clearly increasing temperature trends that are stronger at higher altitudes. Historically GLOFs are a known phenomenon in glacial areas in Bhutan. Under projected temperature trends the risks on GLOF events will increase. Also projected extreme precipitation increases may add to the increasing risks.

Adaptation options for water:

Based on the risk assessment for water including consultations with stakeholders at all levels, several adaption options were identified as part of the final assessment report:

- Strengthening ecosystems is the basis for a resilient water system. The natural capacity for infiltration and water buffering therefore should be maximized by improving the existing system for watershed protection and management. In addition, ecosystem management can prevent fast runoff and erosion. Actions include wetland restoration, reforestation, preventing overgrazing, applying agriculture practices that minimize erosion.

- Improved flood risk management and planning. To create more robust river systems, maximize the discharge capacity of rivers and streams by instituting no build zones, remove bottlenecks

and if needed build emergency storage, bypasses and by controlled releases from glacial lakes. These actions could be prioritized in flood risk management plans.

- Protect critical infrastructures and settlements against floods and landslides by applying flood mitigation structures, slope stabilization, improved drainage systems in urban areas.

- Develop more resilient infrastructure on different levels: i) better planning of roads and settlements to avoid most susceptible areas, ii) climate resilient design of roads, supply and sanitation infrastructures (new or to be replaced), and iii) operation and maintenance of infrastructure (aimed at fast recovery).

- Improve early warning and response and recovery capacity. Expand and improve existing early warning systems for GLOFs and other types of flash floods. Make sure that relief funds (and other mechanisms e.g. insurance) for fast repair and recovery of properties and infrastructures and to compensate for damages are in place.

- Increase robustness of sectoral water supply and demand for drinking and irrigation water. Where needed generate additional water buffers to overcome periods of drought. Low regret actions that can be started at the short-term are the restoration of existing sources, household level rainwater harvesting or creation of additional storage capacity at community level (e.g. in ground water aquifers). It is also important to continue and intensify the improvement of the water use efficiency in domestic and agricultural supply and demand.

- The fast development of Bhutan at some locations (e.g. larger towns, agricultural or tourism centers) may also require a step-change in water supply systems. For the short-term further study could be started to see effectiveness of larger scale multi-purpose reservoirs, larger water supply schemes or sustainable use of ground water can add extra robustness on the longer term.

- Increase the climate resilience of the Hydropower sector through existing and new built hydropower facilities to cope with more erratic flow patterns and increase of disaster risks. Actions include upstream watershed management and downstream disaster risk management as well as exploration of new technologies.

- Enabling actions such as training and capacity building of local experts, planners, and operators. Research on impact and adaptation is needed for example on the contribution of groundwater and the cryosphere to seasonal water availability, on more detailed exposure scenarios (e.g. on future land use and water demand) and at potential and feasibility of specific adaptation strategies. Other actions include monitoring to get a better understanding on climate, hydrology, and impacts on the water sector. It is recommended to choose a comprehensive set of indicators in line with Bhutan water security index (BWSI) system.

2.2.2 Assessment of Climate Risks on Agriculture for National Adaptation Plan (NAP) in Bhutan

Agriculture is an important sector for Bhutan with about half of the population engaged in agriculture and livestock rearing. While agriculture is highly vulnerable to climate change, the agriculture sector in Bhutan already faces major challenges from limited arable land, poor mountainous soils and difficult terrain leading to high costs of marketing and distribution. Current climate vulnerabilities include uncertain weather conditions, pests and diseases and climate hazards such as high variability in rainfall, thunderstorms, hailstorms, and windstorms. Disruptions to agricultural land and the supply chain from extreme events such as flash floods and landslides are threats to food production.

Climate risk assessment for agriculture was conducted using DSSAT (Decision Support System for Agro-technology Transfer) model and GIS mapping at gewog level. The IPCC's concept of climate risk assessment through evaluation of vulnerability, exposure and hazards was used in the assessment (see figure 30). For the risk assessment, 11 crops including different varieties of cereals, vegetables, fruit crops, and spices with economic and food security importance in Bhutan were assessed.

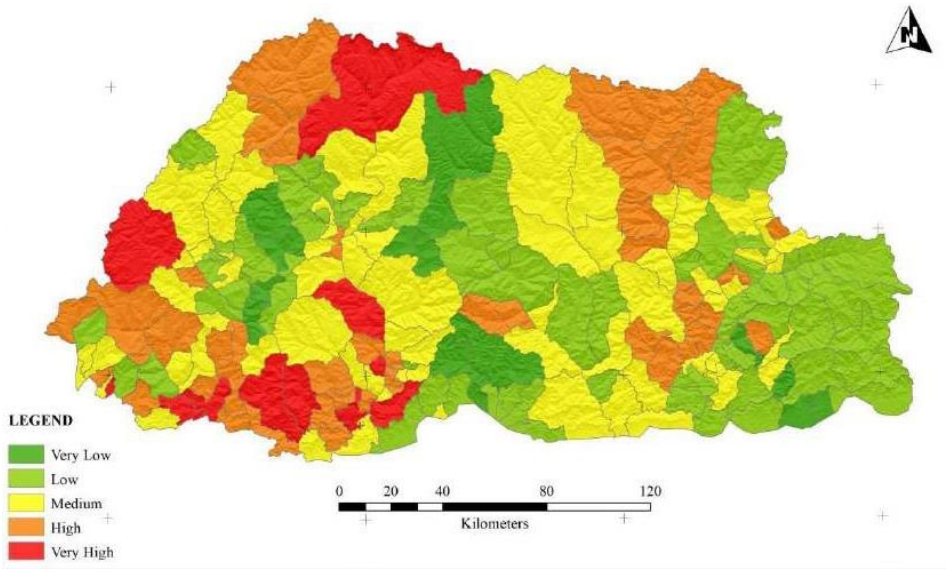


Figure 30: Composite vulnerability map for agriculture.

Results of crop modelling

Key findings of the crop modelling exercise are as follows:

- Paddy can be expanded in 8 dzongkhags (Bumthang, Haa, Samdrup Jongkhar, Sarpang, Trashigang, Trashi Yangtse and Trongsa dzongkhags) and Maize in all the dzongkhags except in Bumthang, Gasa, Haa and Paro
- Quinoa can be further expanded in 8 dzongkhags (Bumthang, Haa, Pema Gatshel, Samdrup Jongkhar, Sarpang, Thimphu, Trashi Yangtse and Wangdue Phodrang dzongkhags)
- Vegetables can be expanded in the following dzongkhags
    - Chillies and potatoes can be expanded in Bumthang, Haa, Paro, Thimphu and Wangdue Phodrang dzongkhags.
    - Expansion in the area is suitable for tomato crops in Chhukha, Haa, Paro, Punakha, Thimphu and Wangdue Phodrang dzongkhags

    - Onion can be expanded only in three dzongkhags viz., Lhuentse, Trongsa, and Wangdue Phodrang.
- In terms of fruits,
    - Citrus can be expanded 7 dzongkhags (Dagana, Monggar, Samdrup Jongkhar, Sarpang, Trashigang, Tsirang and Zhemgang)
    - Apple can be expanded in Bumthang, Chhukha, Lhuentse, Paro, Thimphu and Trashi Yangtse dzongkhags
    - Kiwi can be expanded in Dagana, Samdrup Jongkhar, Sarpang and Tsirang.
- Cardamom, a spices crop can be expanded in Dagana, Haa, Samtse and in Sarpang dzongkhags.

The study shows the current significant trends in climate change, the possibility of further changes, and the growing scope of possible climatic impacts make it imperative to address agricultural adaptation comprehensively. *The study also highlights that there are opportunities for implementing adaptation measures in synergy with mitigation action.*

However, while the study showed potential areas of expansion of the crops, the study notes the limitations in the various types of data inputs, particularly at gewog level. Some of the data limitations included ground realities in land availability, soils pests and diseases, extreme events.

Recommendations for the NAP:

The study identified nine key adaptation measures based on stakeholder consultation and expert opinions. The most common recommendation was on training and capacity development. This includes advocacy for national plans, making farming a lucrative option for youths, better awareness among local leaders and extension agents, climate- smart agriculture, and livestock management training.

1) Enhance water use efficiency and promote sustainable management of water resources
    a. Improved resilience of irrigation infrastructure
    b. Increased water uses efficiency and water management
2) Strengthen Agro-met services and climate information systems
    a. Strengthen Agro-met services and climate information systems
3) Promote and upscale sustainable land management (SLM) programs through enhanced technologies
    a. Sustainable Land and Soil Management
    b. Conserve, develop and promote climate-resilient crop varieties and climate-smart technologies to improve sustainable production systems
    c. Institute pest surveillance systems and strengthen diagnostic facilities
4) Development of integrated agriculture landscape system approach
    a. Development of integrated agriculture landscape system approach
5) Promote landscape based organic farming for enhanced production and sustained livelihood systems.
6) Promote sustainable practices and innovative solutions to reduce crop loss and food waste, improve post-harvest technologies, and institute financing mechanisms to insulate farmers from climate-induced disasters.

a. Develop Integrated Food Framework, Qualified market development and export, promote Crop Insurance and Incentive Systems

7) Climate resilient livestock management.
8) Increase institutional capacity and investment in climate change research.
9) Climate-smart information and knowledge management enhanced.

2.2.3 Climate Mediated Fire Risks Assessment on Forests and Biodiversity for National Adaptation Plan (NAP) Formulation Process in Bhutan

Forests remain central to the wellbeing and prosperity of Bhutan. From providing for water and critical environmental services, forests are inexorably tied to Bhutan's food, water, and energy security. Today, with an estimated 70% of her total land under forests, Bhutan continues to remain carbon negative. Being in the eastern Himalayas, Bhutan's forests are also an amazing repository of biodiversity.

With climate change, forests will be subjected to multiple threats ranging from pests and diseases to diebacks and fire related risks. Fire related damage to forests will severely imperil biodiversity and constrain the provisioning of critical ecosystem services, and fire related loss of forests will significantly reduce Bhutan's carbon sink capacity and endanger Bhutan's ability to remain carbon neutral. Such loss will also, ultimately, compromise Bhutan's constitutional mandate to maintain 60% under forest cover for all times to come.

Fire risk assessment:

Due to the frequent and increasing risks from forest fires, fire behaviour (flame length and rate of spread) was modelled for RCP 4.5 and RCP 8.5 scenarios, for 2021-2051 (short-term), 2052-2069 (mid-term), and 2070-2100 (long-term).

Climate mediated fire risks:

Forest fires in Bhutan continue to take a substantial toll on wildlife and biodiversity with annual fire incidences averaging about 57 events and scarring an average of about 200 hectares annually. Dzongkhags such as Thimphu, Wangdue Phodrang, Punakha, Mongar, Lhuentse and Trashigang have experienced the most fires. Current fires are mostly concentrated in the chir pine and blue pine forests, with occasional fires within sub-tropical broadleaved forests.

The main causes for forest fires are agriculture debris burning; children playing with ignition sources; lemon grass harvesters; smokers; cattle herders; roadside workers; picknickers; campfires; and electric short circuits.

As climate becomes more extreme, both flame length and rate of fire spread will increase. Almost 90% of Chir pine forests fall under high risk from now until 2050, followed by blue pine, with over 60% being subjected to high risk (See Figure 31). In terms of forest areas at risk, Athang and Daga Gewogs in Wangdue, and Saleng Gewog in Mongar, are at most risk within the chir pine zone in the short time frame (now till 2050).

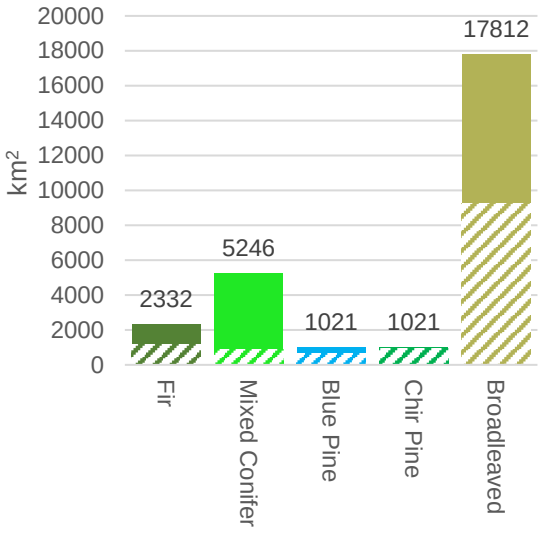


Figure 31: Forest types, area coverage (total height), and portion under risk (hashed section) in each forest type from now till 2050

Although all forest types will be impacted by fire according to risk projections, given the size of broadleaved forests and the fuel models used, broadleaved forests below 2000m asl show up to be at most risk. Given that these broadleaved forests are currently not subject to frequent and intensive forest fires, forest composition and biodiversity in these forests will be severely impacted should fires do occur at the projected rates. Over 9,000 km^2 of broadleaved forests (<2000 masl) are projected to be at high fire risk from now to 2050.

Broadleaved forests will also have most houses at risk from now until 2050, followed by chir pine and blue pine forest belts. An estimated 1,747 households will be at a high fire risk within the chir pine zones as we move from now till 2050 (figure 32), and an estimated 598 households will be at a high risk within the blue pine zones as we move from now till 2050.

Overall, across Bhutan, a total of 18,490 households along with 549 religious structures will be at increased risk from forest fires as we move from now to 2050.

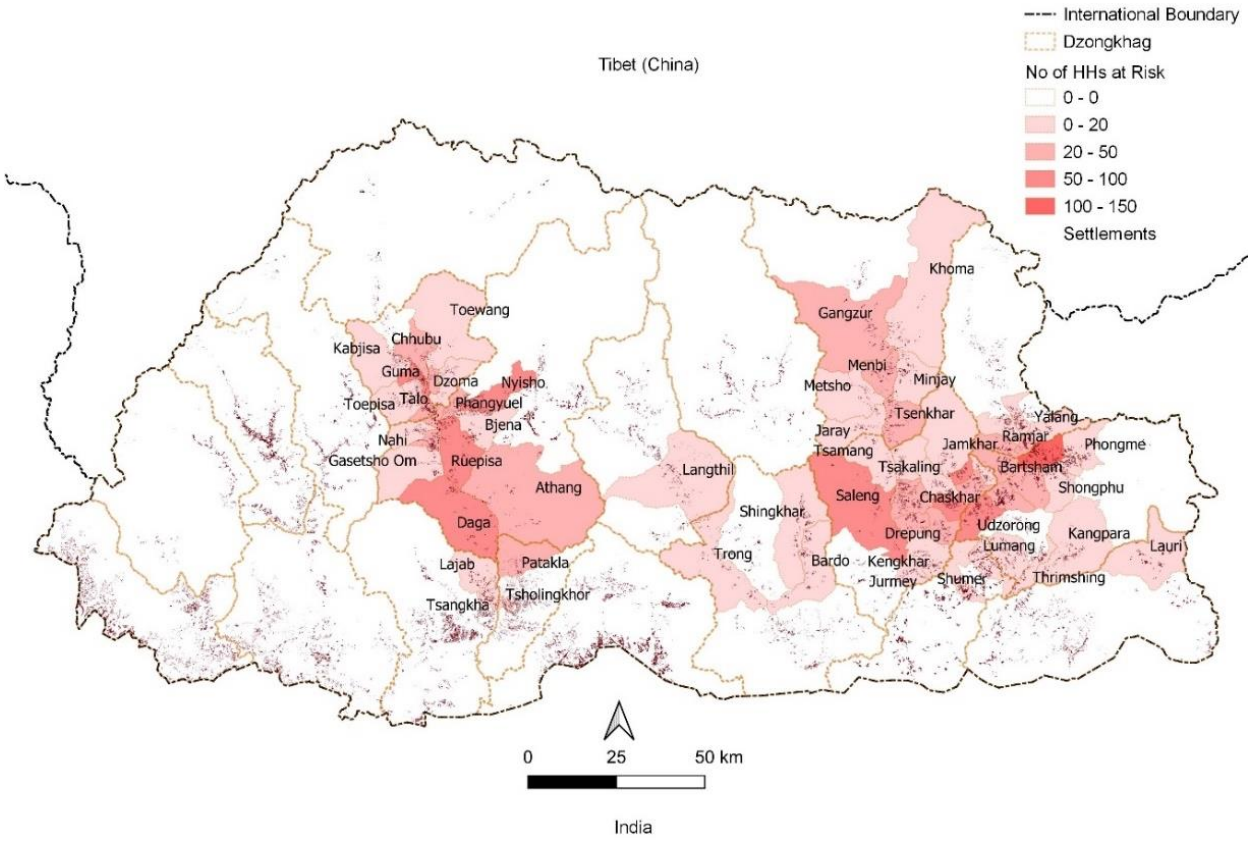


Figure 32: Figure 32: Gewogs with most houses at risk in Chir pine forests under RCP 4.5 from now till 2050

Next steps and recommendations:

In the short-term, the risk of forest fire is most at the mid-altitudes in the temperate montane forests. Risks also extends to the subtropical vegetation zone.

Both flame length and the rate of fire spread are expected to increase in all forest types (except for fir) under both RCP 4.5 and RCP 8.5, and for all time slices. This means forest fires will be more intense with increasing possibility of more crown fires. Coupled with a faster rate of spread, the possibility of larger fires burning over longer periods are an imminent possibility.

In the short (10 years) to medium-term (30 years), given the impending risks, adaptation efforts should be ramped up in high-risk forest types and settlements.

Strengthen Adaptative Fire Management

Within chir pine forests, controlled burning should be encouraged, particularly within lemon grass growing areas, to manage fuel loads. Research into optimal burning cycles, seedling recruitment, burn intensity, mortality and recovery rates, should be initiated immediately to provide management recommendations. The National Forest Policy of 2011 allows for active use of fire as an ecosystem management tool. Within blue pine forests, scientifically determined thinning prescriptions should be

implemented to reduce forest flammability and encourage tree growth to meet economic purposes. Research should also be initiated on how grazing practices mediate forest fuel availability.

Secure Infrastructure at Risk

Adaptation and fire risk mitigation measures should be actively pursued to protect communities and important national infrastructure, where risk of ignition or spread from adjoining forest areas is high. Woody fuels should be removed for 10 meters around structures at risk. In addition, remaining trees and large shrubs should be pruned carefully to raise the crowns 1-2 meters above the ground surface. Water storage systems and fire hydrants should be built around key infrastructure supported by solar powered systems, in case of breakdown in energy supply systems. Fire safety protocols to minimize risk and contain fire outbreaks should be developed and distributed to all facilities at risk.

Reduce Forest Fire Causes

One of the major causes of forest fire is sparks generated by electrical short circuits from powerlines and old transformers. Throughout Bhutan, cross-country electrical transmission and distribution corridors have not been maintained properly and cleared of woody vegetation. A systematic maintenance program for such corridors needs to be established in consultation with relevant stakeholders including Druk Green Power Corporation, Department of Hydropower Services and Bhutan Power Corporation. Apart from the cases relating to electrical short circuits, almost all fires are caused by people and their activities. Therefore, DoFPS should continue to pursue public awareness and education campaigns.

Strengthen Response Capability

The ability to effectively contain and fight forest fire needs to be strengthened, firstly, by equipping the DoFPS, and related fire- fighting partner agencies, with a basic set of fire- fighting equipment. To facilitate faster response times and to minimize risks to humans and property, a daily fire forecasting system based on weather forecasts should be developed and made readily available by region. Such as system should be tied into warning systems which are already being rolled out and implemented by the National Center for Hydrology and Meteorology.

Fires will become larger as the climate warms. In addition, the duration of large fires will increase. A national fire cache should be developed to provide tents, sleeping bags, food, and tools for large, long-duration fires. The DoFPS should identify, build, and manage about two to three such caches at strategic locations to ensure coverage of all Bhutan and effectively manage and control large fires.

All local level forest plans should be integrated so that resource management as well as fire protection objectives are achieved in a holistic and coherent manner. More importantly, consistent budgetary support should be ensured to successfully implement these plans.

Strengthen Outreach & Capacity Building

The DoFPS should schedule and rollout a multi-year training and outreach program covering the following topics:

- Incident management system and coordination
- Equipment handling (including handling of drones, power chainsaws, communication sets, GPS)
- Safety procedures and first aid
- Prescribed burn techniques based on prescribed burn plans

- Smoke jumpers in coordination with the Department of Local Governance and Disaster Management and Royal Bhutan Helicopter Services for first response in areas where there is no/limited access.

2.2.4 Climate Change risk assessment on Health sector for National Adaptation Plan (NAP) formulation process in Bhutan

Several documents related to climate change and health were reviewed for the study. Further, existing academic and grey literature on these subjects were reviewed to understand the linkages between climate change and diseases. As part of this, the Risk-Impact framework proposed by the Fifth Assessment Report of IPCC (IPCC AR 5) was identified as suitable methodology to study climate risks on health in Bhutan. Risk of climate change impacts on health was assessed using IPCC approach of measuring risk (or impact) (R) as a function of hazard (H), exposure (E) and vulnerability (V).

Present Vulnerability and Risk Assessments:

Hazard: The three major components and its indicators used to assess hazards for each of the Dzongkhags are Climate variability, Extreme weather events and cases of Vector Borne Diseases/Water Borne Diseases (VBD/WBD) The overall hazard ranking brings Chhukha, Punakha and Sarpang at the highest for VBDs and WBDs. This is because of various factors such as change in temperature, rainfall, humidity, impact of floods, GLOFs in addition to the Dzongkhag-level cases of the diseases.

Exposure: The current analysis uses population density as exposure. Population density is a key determinant in the spread of diseases and number of people getting impacted due to climate change. Bhutan has around 20 persons/km2. Thimphu has the highest population density (67 persons/km2) followed by Samtse, Chhukha, Paro and Tsirang. Bumthang, Haa, Lhuentse and Gasa have the lowest population density with 4-5 persons/km^2

Sensitivity: Sensitivity reflects the degree of response to a given shift in climate. As a result, the biophysical effects of climate change on environment and community are broadly grouped under the sensitivity component. This includes factors that increase the vulnerability of the system such as demographic profile, changes in ecosystem, urbanization, poverty, and health related indicators etc. On aggregation of all the major sensitivity components, Punakha, Dagana, Zhemgang and Monggar are at the highest sensitivity for Vector Borne Diseases (VBDs) impacts and Lhuentse, Trashiyangtse. Dagana, Monggar and Zhemgang are at the highest for Water Borne Diseases (WBDs).

Adaptive Capacity: Adaptive capacity describes the general ability of systems and individuals to adjust to potential damages, to take advantage of opportunities and to cope with the consequences of climate change. Taking into consideration all sub-components of adaptive capacity – knowledge, infrastructure, access to basic facilities, health infrastructure, Thimphu, Sarpang and Bumthang had the highest adaptive capacity and Gasa, Dagana, Tsirang and Zhemgang had the least.

Risk: When the existing socio-economic and health vulnerabilities are compounded with the climate hazards and population density, Samtse, Chukha, Punakha and Tsirang rank the highest for VBDs while Bumthang, Gasa, Haa and Lhuentse rank the lowest. For WBDs, Punakha, Paro, Samtse and Chhukha are the high-risk districts.

Future Risk Assessments:

To understand how communities/regions may be affected by future climatic change, future climate change risk Dzongkhag level maps were produced. Climate change scenarios - RCP 4.5 and 8.5 and different timescales (2022-2050) were assessed to understand the future evolution of VBD/WBD risk in Bhutan.

Model 1: Future projection for Dengue in Bhutan:

Based on historical disease data for Dengue, projections were prepared under RCP 4.5 and RCP 8.5 scenario for 2021-50, 2051-69 and 2070-2099. The future projections for Dengue show that over the next 30 years, in a business-as-usual scenario, the number of cases in Bhutan can increase to around 3,000 cases per year. These dengue cases would be concentrated in the Dzongkhags of Chhukha, Samtse and Thimphu due to climate variability and pre-existing cases of Dengue that puts these Dzongkhags at increased risk of transmission (figure 33).

For the period 2051-69, the total number of cases per year continue to stay around 3,000 per year, however the severity in terms of the concentration of diseases in previously less affected Dzongkhags increases. Monggar and Trashigang show a higher share of dengue cases as opposed to 2021-59. Under RCP8.5, Trongsa and Samdrup Jongkhar come under high-risk Dzongkhags.

For the period 2070-99, the total number of cases are likely to increase to 4,400 cases per year. The distribution of the cases across Dzongkhags remains concentrated in the three most affected Dzongkhags of Thimphu, Samtse and Chhukha.

Population at risk of Dengue under RCP 4.5 and RCP 8.5 is calculated based on the population projections for Bhutan for the year 2047. Result shows that about 44% of the population of Bhutan is at risk of Dengue and there is an increase in population at medium risk from RCP4.5 to RCP 8.5 scenario.

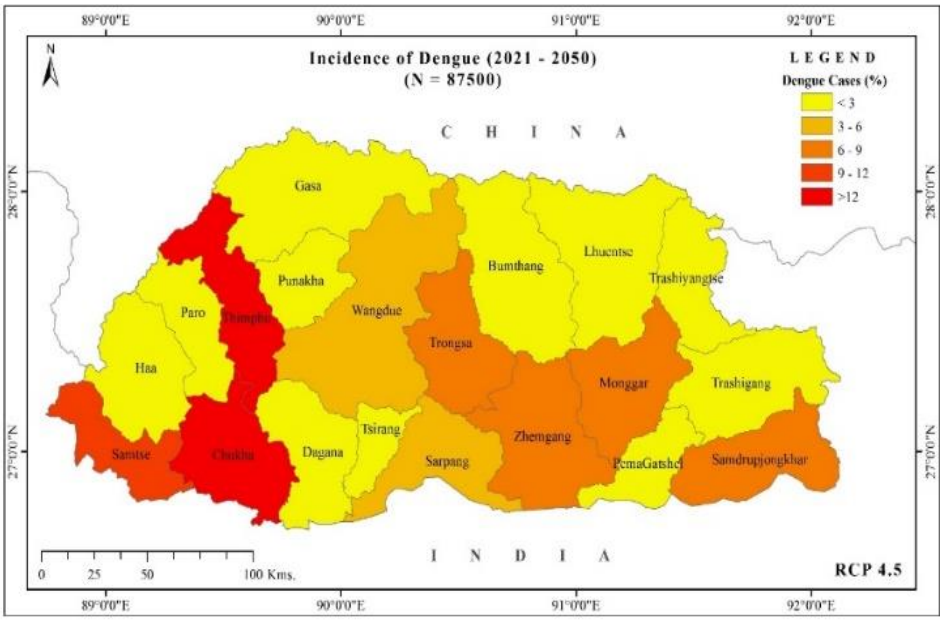


Figure 33: Future projection for climate risk to Dengue under RCP 4.5 (2021-50)

Model 2: Future projection of Malaria cases in Bhutan:

Based on the analysis for future projections of malaria, it was found that rainfall, maximum and minimum temperatures, rainfall at the 3-month lag, maximum temperature at the 3-month lag is positively correlated with malaria incidences at 95% confidence level.

Presently case of malaria is seen in in Sarpang, Chhukha, Samtse, Samdrup Jongkhar and Wangdue Dzongkhag. The future projection of malaria shows that over the next 30 years, in a business-as-usual scenario, the number of cases per year could double under RCP4.5 scenario increasing to around 150 cases per year. Higher percentage share of malaria cases can be seen in the eastern Dzongkhags on the southern border of Bhutan. These are Zhemgang, Sarpang, Pema Gatshel and Samdrup Jongkhar (figure 34). Under RCP 8.5, total cases increase by around 7% and percentage share of cases increase in Samtse. For the period 2051-69, the overall cases reduce, however the geographical distribution of malaria across Dzongkhags is higher under RCP4.5 and RCP8.5 scenarios. Trongsa, Sarpang and Samdrup Jongkhar have the greatest number of cases.

For the period 2070-99, cases increase to around 162 per year under RCP4.5 and 191 per year under RCP8.5 scenario. Dzongkhags with more than 8% of the total cases continue to be Trongsa, Sarpang and Samdrup Jongkhar.

Population at risk of malaria under RCP 4.5 and RCP 8.5 is calculated based on the population projections for Bhutan for the year 2047. Result shows that ~14% of the population of Bhutan is at risk and there is an increase in population at high risk from RCP4.5 to RCP 8.5 scenario.

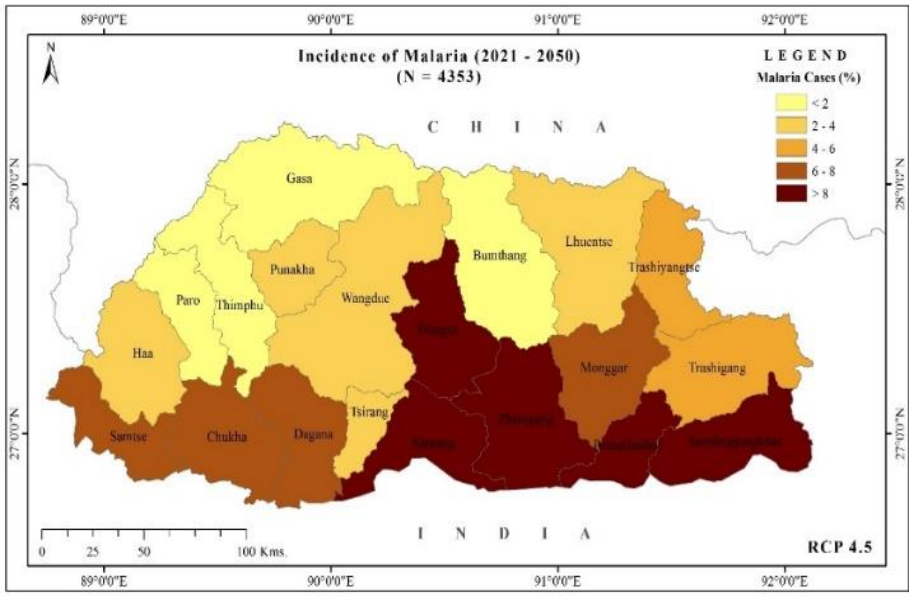


Figure 34: Future projection for climate risk to Malaria under RCP 4.5 (2021-50)

Model 3: Future projections for Diarrhoea:

Based on the Diarrhoea data for the period 2016-20, different future projection models such as the Poisson regression model were applied to understand future projections of diarrhoea in Bhutan. However, none of these models gave a significant correlation between climatic factors and cases of Diarrhoea at the Dzongkhag level. This could be because the observed data on temperature and

precipitation at the Dzongkhag level does not show a consistent correlation pattern with cases of Diarrhoea. The other possibility could be that there is an issue in the disease data for the period 2016-20

Next steps and Recommendations

The integrated analysis based on risk mapping, vulnerability assessment and adaptive capacity identifies Chhukha, Punakha, Samtse, and Tsirang Dzongkhags at higher risk of VBDs and Punakha, Paro, Chhukha and Samtse at highest risk of WBDs. Hence, based on the findings, the study recommends, prioritizing Chhukha, Punakha, Samtse that are common for both diseases followed by Paro and Tsirang. These recommendations focus on adaptation planning for these Dzongkhags predominantly.

In-depth analysis of the identified Dzongkhags and consultations with key stakeholders have helped in identifying the alongside framework for our recommendations.

An overview framework of adaptation planning is also recommended (figure 35) along with interventions at national and regional to local levels in the short to medium and long term.

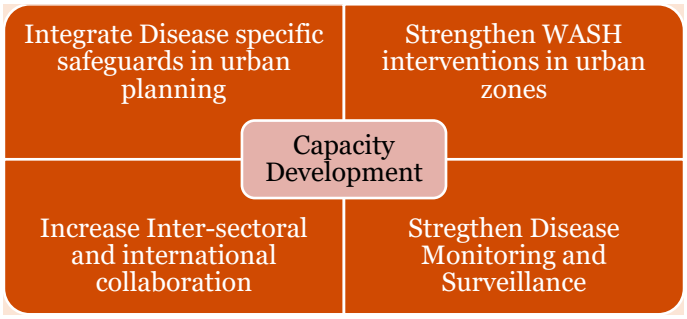


Figure 35: Overview framework of adaptation planning for health.

2.2.5 Climate Change Vulnerability Analyses and Mapping for NAP Formulation Process in Bhutan 2021

A climate change vulnerability analysis (CCVA) and mapping was conducted with a focus on socio-economic and non-climatic, development data. This assessment was carried out to complement the climate risk assessments for key sectors with view of enhancing the understanding of the scale of impact of climate change on a geographic level in Bhutan across dzongkhags and gewogs.

The assessment involved developing an impact chain based on existing literature and studies. Data was gathered from publicly available data sources, along with stakeholder consultations and the vulnerability index and risk index was calculated for each dzongkhag. This was followed by subsequent preparation of GIS maps. The approach was based on the Climate Change Risk Assessment Framework as per the fifth assessment report (AR5) of Intergovernmental Panel on Climate Change (IPCC). The impact chain developed for this assessment and the various components of the risk framework and corresponding indicators is presented in Figure 36. Three levels of projections were carried for (i) climate variability (hazards), (ii) population (exposure) and socio-economy (vulnerability). The time slices for future risk and vulnerability assessments were conducted for 2022, 2027, 2032, 2037, 2042, 2047 and 2050 taking 5-year intervals and aligned to the census years.

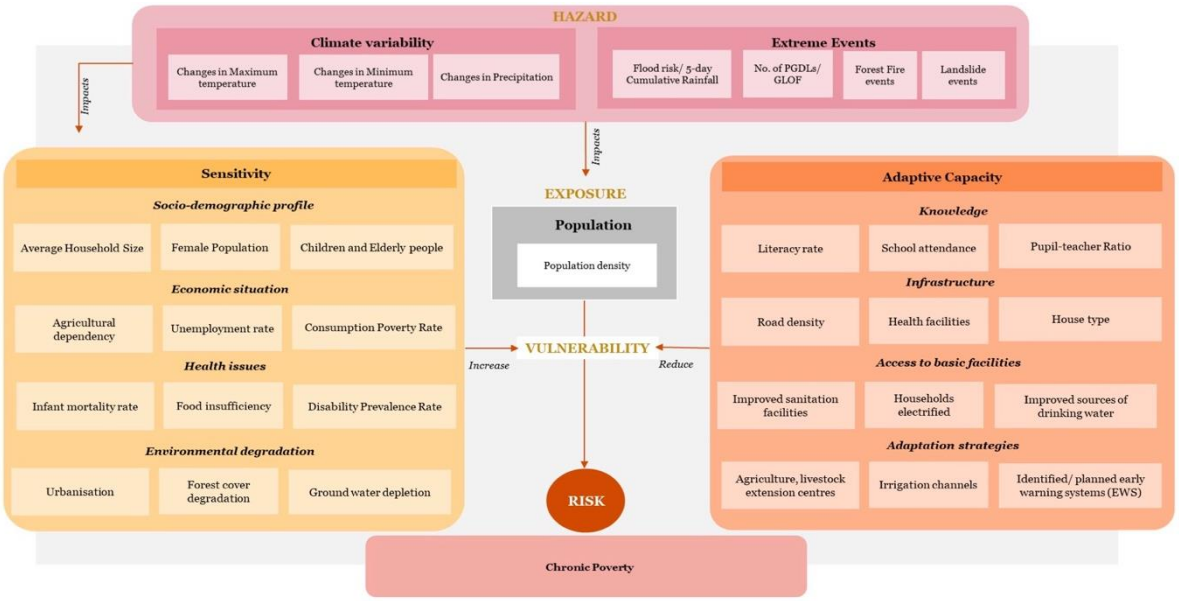


Figure 36: Impact chain and components of the IPCC risk framework and indicators used for calculation of vulnerability and risk across dzongkhags and gewogs in Bhutan.

Results and finding

Present risk

Risk (or impact) is a function of hazard, exposure, and vulnerability and when the existing socio-economic vulnerabilities are compounded with the climate hazards and population density, Samtse, Monggar, Sarpang, Punakha and Dagana as five most at risk from climate impacts in Bhutan (See figure 37).

Figure 37: Present risk ranking across dzongkhags.

Future risk under socio-economic growth and climate change.

Figures 38 and 39 illustrate the future climate risk under RCP 4.5 and RCP 8.5 scenarios respectively. By 2050, under RCP 4.5, Tsirang, Paro, Samtse, Thimphu, Pema Gatshel show very high risk which means a total population of 469,595 will be exposed to a very high climate change risk. Dzongkhags like Thimphu with high adaptive capacity are at risk due to the high density of population that is exposed to climate hazards. The risk maps also indicate that future risk status remains unchanged in almost all the Dzongkhags during the period between 2022 and 2050. Dzongkhags like Punakha, Samdrup Jongkhar, Zhemgang, Sarpang, Trashiyangtse show an increasing trend in relative ranking of future risk.

This CCVA mapping exercise provides information about the social and economic impacts of climate change to inform adaptation planning and prioritisaion of geographic areas during implementation.

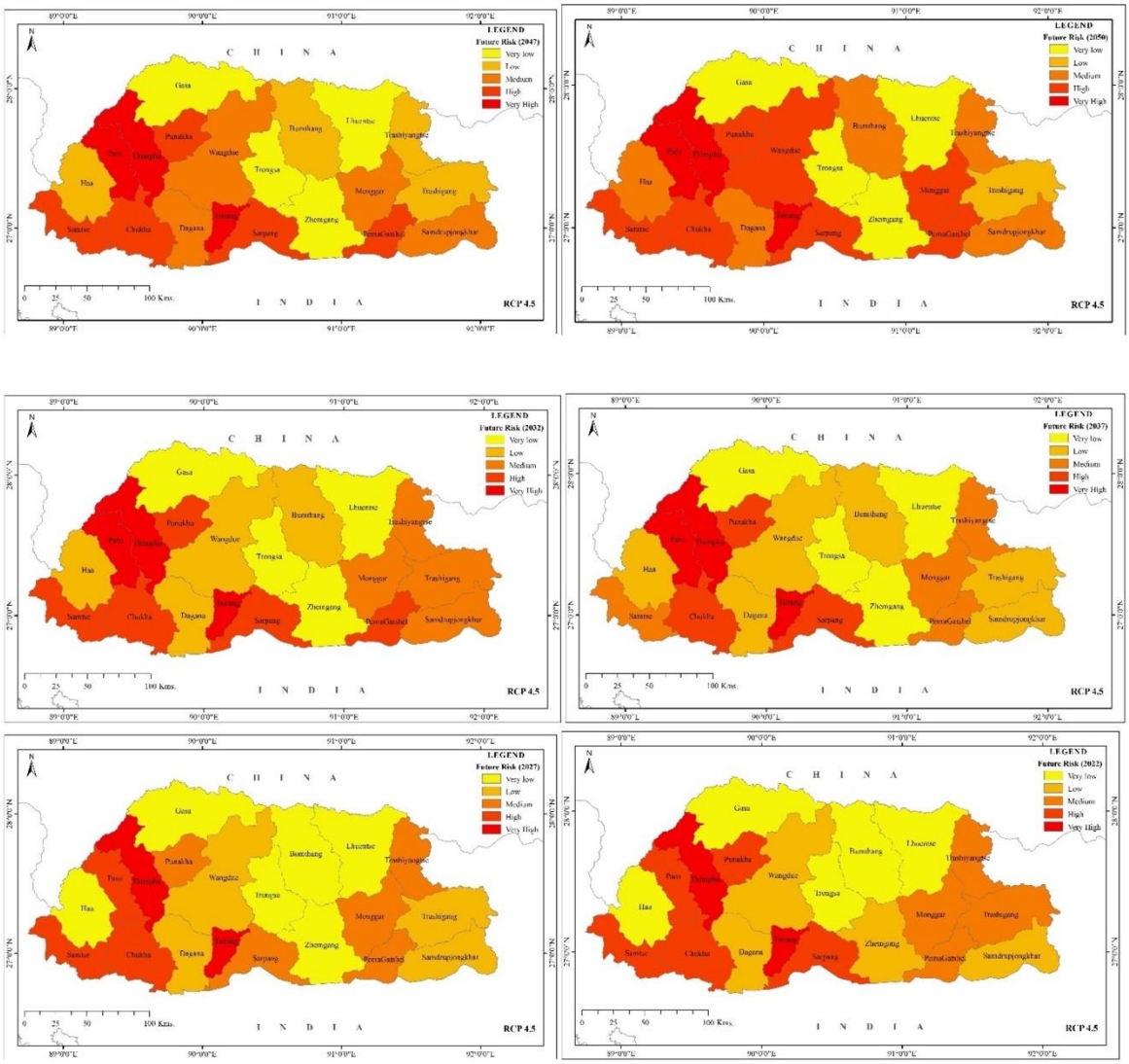


Figure 38: Future climate risk across Bhutan under RCP 4.5

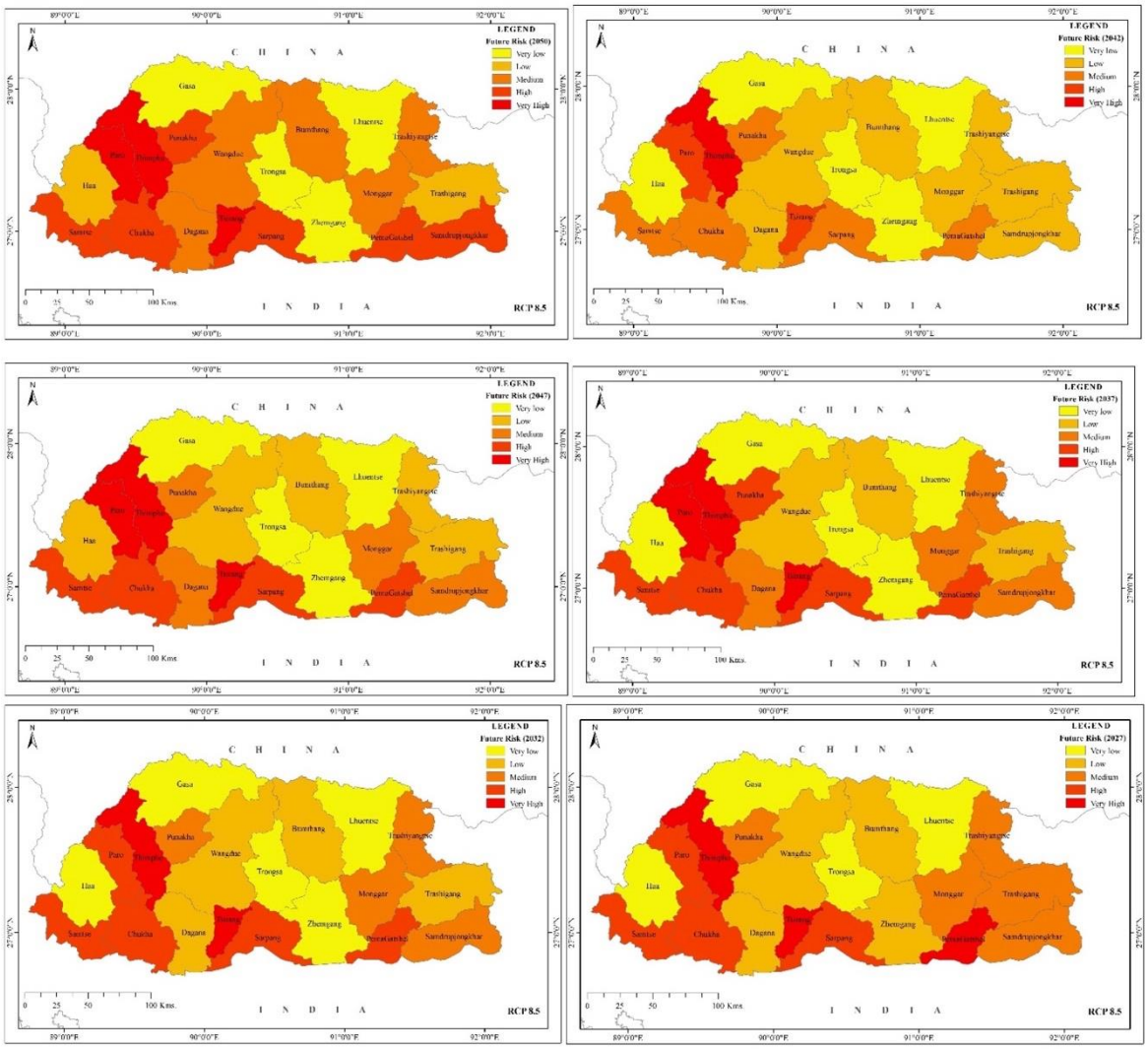


Figure 39: Future climate risk across Bhutan under RCP 8.5

3. ADAPTATION PRIORITIES, NEEDS AND ENABLING ACTIVITIES

The priority needs for adaptation and the enabling activities have been determined based on the vulnerability assessments as described in Chapter 2 and several rounds of technical workshops and stakeholder consultations as described in Chapter 1 under the description on NAP preparation process. The NAP consolidates the priority actions and needs from recent vulnerability assessments under the NAP Readiness Project as well as the adaptation priorities previously conveyed in the 1st NDC (2015), and the Third National Communication. In addition, other cross cutting strategies such as the National REDD+ Strategy, National Biodiversity Strategic Action Plan (under UNCBD), National Action Plan (under the UNCCD) and other sectoral strategies were also consulted.

This chapter presents the following categories of priorities, needs and actions.

(i) priority actions and needs to address vulnerabilities and climate risks across seven sectors,
(ii) enabling activities required to support the implementation of the priority adaptation needs and ensuring an effective NAP process.

The organisation of the key priorities for adaptation and enabling activities follow and build on the format in the third national communication to ensure coherence and continuity in adaptation planning and communication. Activities have been identified for strategic objectives and actions over the short term (up to 5 years) and in the medium term (over 5 – 15 years). The two timeframes are intended as a rolling workplan for the continuous, iterative, progressive nature of adaptation planning and implementation.

The priority needs and actions are presented as summaries in this chapter and further details including key performance indicators, estimated costs, and responsible agencies and collaborating partners are presented in Part II of the NAP document. The summary of the estimates cost for the detailed adaptation priorities and enabling activities are in annex 1. All costs are estimated based on expert judgement and are subject to change during further evaluation when actions and programs are further developed for implementation as part of projects or integrated into national plans programs.

Approaches to consolidating the numerous adaptation priorities into few thematic programs or programmatic approaches is explored in Chapter 4 as part of the implementation strategies.

As discussed in Chapter 5 on monitoring and evaluation, key performance indicators (KPI) have been included to aid the monitoring and evaluation for the implementation of the NAP. Furthermore, the structure of the priorities, needs and enabling activities in this chapter is also intended to support future reporting on the NAP, Adaptation Communication and for the Biennial Transparency Reporting.

While developing the adaptation priorities and needs, the opportunities for integrating gender considerations and the engagement of the private sector were also reviewed and included (see text box 3).

Box 3: Gender considerations in the NAP process.

Gender integration in the NAP Process for Bhutan:

The principles of the NAP process call for including gender equality considerations and disaster risk management. While assessments of gender issues in climate change in Bhutan has not been assessed or studied, a limited number of reports have been produced in recent times. The 'Gender and Climate Change in Bhutan, with a focus on selected Nationally Determined Contribution (NDC) Priority Areas: Agriculture, Energy and Waste' prepared by the NCWC and NEC in 2020, covers a few limited sectors. A few other scoping reports for project proposals were also prepared in previous years.

Nevertheless, the preparation of the NAP process used a concerted effort to integrate gender issues wherever possible based on the information available and the consultation process. Gender considerations have been included in the preparation of Bhutan's NAP as follows:

Differentiated impacts of climate change: all Climate change risk assessments done for the four key sectors of health, agriculture, forests & biodiversity, and water analysed differentiated impacts of Climate change on gender and provides recommendations for addressing differentiated impacts of Climate change on gender.

Stakeholder engagement: the stakeholder engagement plan developed for the NAP process identifies gender as an integral part of the National adaptation planning and clearly specifies the role of gender and agencies like NCWC while at the same time ensuring gender consideration in national polices, plans and strategies.

NAP Formulation: while developing the adaptation priorities and needs, the opportunities for integrating gender considerations and the engagement of the private sector were also reviewed and included.

NAP Document: gender considerations, traditional and local knowledge are integrated into the priorities and plans and throughout chapters of the NAP, including as specific activities in the adaptation priorities and needs.

M&E for NAP: to ensure adaptation activities when implemented considers the differences in knowledge level, capacity, needs of women and benefits from adaptation implementation are reaped by all section of the communities. Gender disaggregated data for monitoring and reporting is to be collected.

Capacity enhancements: educating for identifying gender differences in adaptation needs and capacities, participation and influence in decisions making, and benefits resulting from investments in adaptation is equitably accessible.

3.1 Adaptation Priorities and Needs

The priority adaptation needs are clustered as programs and actions over seven thematic sectors. While it was found that many of the priorities are cross-cutting in nature and interlinked, the seven sectors are prioritised based on a review of vulnerable sectors from several exercises and strategies such as the Stocktaking for the NAP process, the Third National Communication, the Adaptation Component of the first NDC, and other climate programs such as the Strategic Program for Climate Resilience and Country Work Program for the GCF.

The types of interventions across the seven sectors ranged from direct interventions through technology transfer, infrastructure investments, to soft components such as market access, capacity building and management of information and data. Two thematic approaches also emerged prominently across the sectors and among the variety of actions and activities, in the form of

ecosystem-based adaptation approaches (landscape, habitats, forests, ecosystems, watersheds) and human settlement services (rural and urban). Priorities for climate services and disaster risk reduction are considered as cross cutting issues.

The final seven sectors identified for the NAP are:

(i) Water
(ii) Agriculture and Livestock
(iii) Forests and Biodiversity
(iv) Human Settlements & Climate Smart Cities
(v) Health
(vi) Energy
(vii) Climate Services and Disaster Risk Reduction

A summary of the adaptation priorities across the seven sectors is presented below. These priorities are presented in further detail in Part II of this NAP document.

3.1.1 WATER

The vulnerability of water resources is identified as one of the major climate risks in Bhutan and will affect all sectors, from food production, energy, human settlements, and the industry. The priorities in the water sector are therefore cross cutting across many sectors and stakeholder groups. The adaptation priorities in water sector take a holistic approach including nature-based solutions. The interventions range from securing and managing natural sources of water to ensuring optimal use and management of water for drinking. Ensuring efficient and sustainable use of water for agriculture and other key infrastructure investments is also included for the water sector to ensure an integrated approach to water management. The management of water discharge after consumption for human needs is covered in the priorities for human settlements. The strengthening of institutional capacity for water management including enhancing existing institutions like water user groups, strengthening capacity of key stakeholders and continuing research is essential to support a continuous and iterative adaptation.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
1	Improve natural capacity for infiltration, water recharge, and water buffer for prevention of fast runoff and erosion.	Healthy and resilient functioning ecosystem for water services.	Ecosystem based adaptation to ensure natural capacity for water infiltration and recharge through; (i) Ecosystem restoration. (ii) Watershed management (iii) Promotion of traditional knowledge and practices in water conservation.	Assessment of wetlands, watersheds and spring sheds and development and implementation of intervention measures. Integrating of existing watershed management interventions into Local Area Plans/settlement plans and its implementation Restoration of existing water sources.	Effective implementation of water legislation and IWRM. Sustainable management of wetlands, watershed, and spring sheds. Conduct watershed modelling.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
				Implementation of Ecosystem based Adaptation	Monitor infiltration, water buffers, fast runoff, and erosion.
			Strengthen and upscale PES.	Strengthen and upscale PES. Review PES framework and field guide	
2	Optimal use of available water discharge	Robust water resources planning and monitoring system.	River basin planning.	Conduct feasibility studies to build emergency storage, bypasses, and controlled releases from glacial lakes. River basin management and planning for basin optimization.	Build emergency storage, bypasses and controlled releases from glacial lakes if found feasible. Monitoring and evaluation of river basin management plan
			Promotion of water efficient technologies	Enhance research and development on water efficient technologies. Conduct advocacy on water efficient technologies	
3	Ensuring climate resilient supply of safe drinking water under climate change.	Improved access to safe drinking water.	Ensuring proper monitoring, planning and supply of drinking water	Assessing the efficiency of existing water treatment facilities and water supply network systems. Explore alternative water supply technologies. Expand the implementation of Water Safety Plans (WSPs) and proper water supply systems with adequate design. Awareness programs for efficient water use. Provide training on plumbing water management and other related skills. Develop operation and maintenance guideline and standard	Explore and improve water treatment and supply network systems with proper management mechanisms. Explore and build additional storage facilities.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
			Harvesting rainwater/fog for domestic use	Exploring volume of rainwater generated at water stressed areas for domestic use. Developing assessment guide for integration of holistic use of water resources	Integrating rainwater/fog harvesting structures into buildings and other amenities
			Reduction of Non-Revenue Water losses	Study of NRW in critical areas.	Implementation of improvements to reduce NRW.
			Strengthen drinking water quality monitoring and surveillance	Strengthening laboratory services to test and monitor water quality	Strengthening water quality and monitoring information systems
			Strengthen database/inventory on drinking water supply schemes		Establishment of a real time water supply monitoring system
4	Enhance water use efficiency and promote sustainable management of water resources for agriculture	Improved resilience of irrigation infrastructure	Improve planning, designing and implementation of climate resilient irrigation infrastructures and systems	Climate proofing of the irrigation facilities (HDPE/concrete)	Climate proofing of the irrigation facilities (HDPE/concrete)
				Exploring alternative means of irrigation (solar pumps and lift irrigation)	
			Strengthen database/inventory on irrigation schemes	Development of irrigation schemes database system	Conduct modelling and simulations of discharge for proposed irrigation schemes
5	Strengthen institutional capacity for water management	Robust water resources planning and monitoring system.	Strengthening Water User Associations (WUAs).	Review and strengthen WUAs. Implementation of WUA guidelines. Training on IWRM, formation of WUA and legalization, (management, accounting, etc.).	Monitoring and evaluation of WUAs.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
			Strengthening research on water resource management including groundwater resources.	Research on water resource management including groundwater resources and soil moisture. Enhance hydrological and groundwater modelling. Carry out studies on the options for household/institution level rainwater harvesting or creating additional water storage capacity. Assess climate risk on water intensive industries (168 water intensive industries as of 2022)	Initiate use of groundwater or discontinue based on findings from the study.
			Enhancing capacity of key stakeholders in managing the impacts of climate change on water	Capacity development on climate resilient water infrastructures Training onsite inspection, Aerial survey using Drones and mapping using GIS	Capacity development on climate resilient water infrastructures
				Capacity development of flood and storm water management from river flooding and urban floods.	
				Capacity development to generate forecast information at sub-basin level so that early warning. information is disseminated on timely basis to all sectors/communities. at suitable temporal (Daily to seasonal) and spatial (from river basin to sub-catchment) scale.	Information disseminated on timely basis to all sectors/ communities. A robust real to near real time information dissemination system with customizable to requirements of different sectors.
				Build capacity for decision making and management of critical communication infrastructure, through development of Road Asset Management System (RAMS),	Continuous updates for technology and refresher training.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
				Develop Decision Support System, GIS and other tools	

3.1.2 Agriculture and Livestock

Agriculture and livestock sector is an important sector for Bhutan with 51% of the population employed in agriculture and contributing about 17% of GDP. While food security is a key national priority, climate change impacts such as changes in water availability, increasing pests presents risks to the sector. The adaptation priorities for both agriculture and livestock are grouped in interventions for securing the resource base, managing losses from climate impacts and emerging threats, and enhancing resilience in food production. The interventions include integrated landscape approaches including sustainable land management, appropriate technologies, and management practices.

The agriculture and livestock sector presents strong synergies for climate mitigation through landscape approaches such as agroforestry, sustainable soil and land management, promotion of organic and good agricultural management practices. The role of the private sector is identified in several areas of food production, market access, supply chain for the sector and risk management. Opportunities for integration of gender issues through appropriate technologies and engagement of women's groups are also identified. Recent lessons from the COVID-19 pandemic such as risks in supply chain, food banking and risk of zoonotic events have also been integrated. Targeted training at sector and the decentralised level is also required for enhanced risk assessments and adaptation implementation.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
1	Securing the natural resource base for livestock grazing feed and fodder sources	Reduced vulnerability of livestock farmers	Efficient utilization of alpine rangeland and development of agroforestry systems for livestock	Identify and set up permanent research plots to study the impact of climate change on diversity of grasses in rangeland. Improve alpine rangeland governance system	Continue research and monitoring
				Sustainable management and utilization of alpine rangeland resources	Sustainable management and utilization of alpine rangeland resources
				Mapping and identification and assessment, of indigenous forage/grass species	
			Enhanced availability of feeding resources	Promote resilient fodder tree plantation.	Promote resilient fodder tree plantation.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
			through agro-forestry system	Promote production of local feed raw materials	Expand acreage for raw feed material production
				Promote pasture under agro-forestry system (orchard, silvo pastoral)	Expand pasture under agro-forestry system (orchard, silvo pastoral)
				Upscale usage of crop residues through enrichment and fodder conservation	Upscale usage of crop residues through enrichment and fodder conservation
2	Enhancing resilience and livestock production through appropriate technologies and management practices	Enhanced adaptive capacity of livestock farmers and the livestock sector by increasing sustainable production	Conservation and promotion of climate resilient native livestock breeds	Conservation and development of native poultry breeds	Continue program for Conservation and development of native poultry breeds
				Conservation and development of native piggery breeds	Continue Conservation and development of native piggery breeds
					Development of suitable Bhutanese cattle breed through cross breeding
					Promotion of advanced livestock reproductive technologies (Sex sorted AI, ET,) for enhanced dairy productivity
			Promote climate smart livestock farming practices through gender- and PWD-friendly farm-level technologies.	Promote Effective Microorganism Technology (EMT) in poultry and piggery farms	
				Fencing on pastureland to reduce incidence of wildlife depredation on livestock	

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
				Improve micro-climate conditions in animal sheds	
				Expand apiculture for boosting honey production and enhance crop productivity	Expand apiculture for boosting honey production and enhance crop productivity
				Water efficient and low-cost fodder production during lean season (hydroponics)	
				Promote heat and cold resistant fodder varieties	
				Adopt labour saving devices and equipment to reduce drudgery on women and vulnerable groups	Scale up labour saving devices and equipment to reduce drudgery on women and vulnerable groups.
			Efficient utilisation of natural water bodies and land resources to boost fish production	Expand community-based capture fisheries.	
					Explore cage culture fisheries in inland water bodies and hydropower dams
				Explore and introduce low-cost fish production technologies (aquaponics)	Explore and introduce low-cost fish production technologies (aquaponics)
			Utilization of spatial information, remote sensing, and ICT for delivery of efficient and effective livestock services	GIS application for livestock development (to map migratory cattle and yak herds)	
				Digitalization to generate real time data for informed decision making	Digitalization to generate real time data for informed decision making
3	Managing livestock losses	Reduced vulnerability	Strengthen surveillance and	Strengthen capacity of livestock research centres and	Strengthen capacity of livestock research centres

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
	from climate change impacts and emerging threats	of livestock farmers against losses from climate change impacts	forecasting system for prevention and control of emerging animal diseases and threats under climate change	laboratories to address emerging threats from climate change impacts	and laboratories to address emerging threats from climate change impacts
				Institute recording and reporting system on livestock lost due to climate induced extremes	
				Improve farm biosecurity	Continue outreach and communication for farm biosecurity
				Strengthen transboundary animal disease reporting and management system	
				Initiate herd health management	
				Promote and popularize traditional knowledge and practices for safe and sustainable livestock production	Continued research, outreach and communication on traditional knowledge and practices for livestock production.
4	Enhance water use efficiency and promote sustainable management of water resources for agriculture	Improved resilience of irrigation infrastructure	Improve planning, designing and implementation of climate resilient irrigation systems at farm level	Promote adoption of micro irrigation (Drip, sprinkler) by increasing accessibility to farmers through simple, affordable, and smart technology	Promote adoption of micro irrigation (Drip, sprinkler) by increasing accessibility to farmers through simple, affordable, and smart technology
				Rehabilitation of the traditional irrigation system to reduce water loss through climate proof structures integration	
				In-situ water harvesting - diverting, inducing, collecting, storing, and conserving local surface runoff, spring water	

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
				and rainwater for agriculture production	
					Explore tail water management and usage.
5	Pursue an integrated landscape approach for sustainable soil and land management for agriculture	Increased resilience of the land and ecosystem for food production and nutrition security	Promote and upscale sustainable land management (SLM) programs through enhanced technologies	Improve soil carbon, health, and fertility through adoption of improved and integrated soil nutrient management practices	
				Residue management including bio-degradable mulching	
				Agriculture land development	
				Mapping of degraded areas, and soil erosion	Mapping of degraded areas, and soil erosion
				Establish soil organic carbon monitoring, accounting, and reporting under different crop land	
			Development of integrated agriculture landscape system approach	Promote Bhutan Good Agriculture Practices (GAP) and GMP	Promote Bhutan Good Agriculture Practices (GAP) and GMP
				Strengthen Bhutan GAP certification process	Continue Bhutan GAP certification process
				Promote perennial crop (fruits & plantation crops production to enhance small holder farm income and improve climate resilience production system	Promote perennial crop (fruits & plantation crops production to enhance small holder farm income and improve climate resilience production system
6	Managing food production losses from climate change impacts and	Reduced vulnerability of farmers against losses from climate	Institute pest surveillance systems and strengthen	Strengthen pest surveillance system and diagnostic facilities	

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
	emerging threats	change impacts	diagnostic facilities		
				Develop and Promote Integrated Pest Management technologies	
			Promote sustainable practices and innovative solutions to reduce crop loss, food waste and improve post-harvest technologies through improved value chain development to enhance resilience of farmers	Develop efficient post-harvest infrastructures and distribution system.	
				Promote cold storage facilities for agriculture products	
				Establish efficient cold chain facilities at strategic locations for livestock products	Establish efficient cold chain facilities at strategic locations
				Develop and promote local agro-diversity and knowledge-based products	
				Assessment of food/crop losses in the food value chain (harvest, storage, transportation, consumption)	
			Institute climate risk management for food production through insurance and compensation schemes covering climate change impacts	Initiate and promote insurance of livestock against wildlife depredation and extreme climate conditions	We suggest policies developed.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
				Develop safety nets (example: Crop insurance and credit facilities) to cope during extreme weather events	
7	Enhancing resilience and food production through appropriate technologies and management practices	Enhanced sustainable practices and innovative solutions for food production and management	Ensure women's/ Vulnerable group access to gender friendly technologies at farm level	Adopt innovative, gender responsive technologies for smart climate resilient farming	
			Explore, develop, and promote climate resilient crop varieties and climate smart technologies to improve sustainable production systems	Inventory/improve and promote climate resilient indigenous varieties to adapt to climate change impacts	Inventory/improve and promote climate resilient indigenous varieties to adapt to climate change impacts
				Generate/develop/breeding and promote climate resilient crop varieties	Generate/develop/breeding and promote climate resilient crop varieties
				Increase cropping intensity through intensive climate smart cultivation systems (greenhouse, hydroponics, aeroponics, vertical farming)	Increase cropping intensity through intensive climate smart cultivation systems (greenhouse, hydroponics, aeroponics, vertical farming)
				Generate/develop and promote and diversify nutri-dense crop varieties	Generate/develop and promote and diversify nutri-dense crop varieties
				Promote energy efficient and gender friendly farm machineries	Promote energy efficient and gender friendly farm machineries
8	Conduct targeted training at sector and decentralized level for	Targeted and enhanced capacity building for adaptation	Assess capacity needs for adaptation planning and implementation.	Conduct capacity needs assessment (HR, infrastructure & equipment) of relevant government institutions, SOEs and	

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
	enhanced assessment and implementation of adaptation	for food security		communities for climate change adaptation.	
			Targeted training on impacts of climate change in food production at sectoral to community levels.	Capacity building of technical officials on climate change impact on agriculture productivity and food security - including farm household models for strong decision making	
				Capacity building of livestock field staff and farmers	Capacity building of livestock field staff and farmers

3.1.3 Forests and Biodiversity

Bhutan's forests cover most of the country's land area (70.77%) and is a major factor in Bhutan achieving carbon neutral status. The forests are also a source for natural resources such as timber, non-wood forest products and other ecosystem services including as a store for fresh water. Furthermore, the different forests provide a variety of habitats for the rich biodiversity of Bhutan. Climate change poses great risk to forests and biodiversity, through potential changes in habitats and ecosystem functions. The increasing risks of forest fires due to drier and warmer winters not only threatens biodiversity but could also jeopardise Bhutan's carbon sinks.

The adaptation priorities for forests and biodiversity are developed in a highly synergistic approach and contributes to mitigation (carbon sink management) in line with the National REDD+ Strategy (NRS), biodiversity conservation in line with the National Biodiversity Strategy and Action Plan (NBSAP), and disaster risk management. The interventions also aim to engage communities, private sector, and vulnerable groups as partners in management of the natural resources through people-centric programs. Opportunities to integrate gender responsive measures have also been included to the extent known and possible.

The adaptation priorities address the great risk from forest fires, enhancing the assessment and monitoring of biodiversity under climate change, along with restoring and managing important areas and components of biodiversity in Bhutan. Invasive alien species and other emerging risks like zoonosis and spread of pest and diseases have also been identified in the wake of the COVID-19 pandemic. Key interventions also include management of forest and biodiversity through scientific sustainable management and community engagement.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
1	Strengthen forest fire management in Bhutan through participatory and consultative approach	Minimized risk of forest fire	Develop and implement fire management strategies and plans.	Develop and implement the forest fire management strategy and plans	Continue implementation of the plan
			Strengthen response capability on forest fire management	Conduct Capacity Need Assessment and build capacity.	Conduct periodic training on forest fire management for multi stakeholders
				Upscale and strengthen the Dzongkhag level fire management interventions. Integrate Dzongkhag and local level fire management plans	Implement advance early warning systems
				Strengthen forest fire surveillance and communication system (including forest fire suppression equipment)	Strengthen support for large fires and IFCG
			Enhance awareness on forest fire management.	Develop awareness program/ materials and carry out awareness	Carry out awareness campaigns
			Strengthen adaptive forest fire management	Manage fuel load	Manage fuel load
				Carry out post fire habitat management	Carry out post fire habitat management
2	Enhance assessment and monitoring of biodiversity	Updated information on Biodiversity	Carry out long term monitoring of biodiversity and habitats	Develop capacity to monitor biodiversity and support implementation of Bhutan Biodiversity Monitoring Protocol	Continue support to implementation of biodiversity monitoring protocol
				Strengthen existing database systems.	Updating the revamped database system
		Changes in distribution of flora and fauna researched	Build capacity to conduct national inventories and biodiversity surveys	Build capacity to conduct NFI and biodiversity survey	Develop database systems and implement the database to document and monitor

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
		and documented			
			Conduct periodic National Forest Inventory	Develop NFI database	Develop capacity to conduct NFI and data analysis
					Procure equipment and conduct NFI
			Develop a dynamic technology system to track the real time forest cover change	Develop and implement online National Forest Monitoring Portal to monitor forest cover change on real time basis	Integrate National Forest Monitoring Portal into the existing NFMS
			Strengthen biodiversity assessment methodologies and techniques (molecular techniques for species delimitation)	Assess and enhance technical capacity and infrastructure	Implement molecular techniques and methodologies for biodiversity assessment
			Develop City Biodiversity Index	Stock-taking and identifying the baselines and developing the index	Regular monitoring and evaluation of the initiatives and awareness.
3	Identify, restore, and manage key important areas and components of biodiversity	Key important biodiversity conserved, and climate resilience value habitats improved	Enhance plantations and regeneration in SRF land	Develop suitable guidelines for plantations and regeneration in broadleaved forest	
				Assess existing plantations and formulate suitable plantation techniques and regeneration methods	
				Carry out plantation in identified broadleaved forest (FMUs, LFMAs) and maintain these sites through community engagement	Carry out plantation in identified broadleaved forest (FMUs, LFMAs) and maintain these sites through community engagement
				Carry out reforestation in degraded areas in SRF	Maintenance of reforestation in degraded areas in SRF

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
			Rehabilitate habitats and carry out plantation	Identification and mapping of sites requiring restoration and rehabilitation	
				Carry out habitat management interventions such as enrichment plantations, grassland and alpine meadow management, salt licks, snags, waterholes, river back protections, etc. in identified areas	Carry out habitat management interventions such as enrichment plantations, grassland and alpine meadow management, salt licks, snags, waterholes, river back protections, etc. in identified areas
			Promote ex-situ conservation of species with high risk of extinction	Identification and mapping of fragile habitats and species	
				Develop and implement sustainable restoration plans.	Implement sustainable restoration plans.
			Develop legal framework for inclusion of wildlife movement friendly infrastructure to enable long term migration under climate change	Development of the legal framework	Approval and implementation of the framework
			Enhance Zero Poaching Strategy and reduce environmental crimes	Support to implementing the existing Zero Poaching Strategy	Revise and implement Zero Poaching Strategy
4	Prevent and control the increasing incidences of zoonosis, pest and diseases and Invasive Alien Species (IAS)	Incidences of zoonosis, pest and diseases and IAS are minimized and managed	Strengthen surveillance and monitoring of zoonosis, pest, and diseases.	Identify and map areas prone to pests and diseases, and initiate periodic monitoring and surveillance	Continue periodic monitoring and surveillance of the identified areas.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
				Project pest and disease spread through scientific modelling	Develop required mitigations/interventions based on the results from the monitoring.
				Develop pest and disease strategy and management plan, and support implementation	Continue implement pest and disease strategy and management plan.
				Implement program to monitor risk of emerging zoonotic diseases and implement response measures.	
				Support implementation of wildlife health strategy	Support to review the wildlife health strategy and continue to support implementation.
				Develop capacity on GIS & RS, entomology, and Drone mapping	Develop capacity on GIS & RS, entomology, and Drone mapping
			Build capacity on assessment, control, and management of invasive species	Tools and equipment for control of alien species.	Implementation of the strategy
				Training on techniques for control of alien invasive species	Development of management plan for priority alien and invasive species outside protected areas.
			Reduce the impacts of IAS on biodiversity forest ecosystem	Implement IAS management plan	Strengthen surveillance and monitoring of IAS.
				Prevent introduction and establishment of IAS and manage existing IAS	Prevent introduction and establishment of IAS and manage existing IAS.
5	Control and prevent degradation of forest cover and biodiversity through scientific sustainable	Livelihood of communities improved and their support towards conservation and sustainable forest	Enhance landscape approach to conservation and promote alternative livelihood sources through nature-based solutions/adaptation	Support socio-ecological assessment of Transboundary Peace Park and support development and implementation of its management plan.	continue support to implementation of the management plan of the Peace Park

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
	management and community engagement	management enhanced in the Landscape			
				Identification of Other Effective Area Based Conservation Measures (OECMs) and development of plans for identified areas.	Implementation of the management action plans
				Support to implementation of the Human Wildlife Conflict Management (HWCM) Strategy	Revise and implement the HWCM Strategy.
				Support to implementation of the PA management plan	Support to revision of climate smart management plans of PAs and implementation.
				Promote Community Based Natural Resource Management (Community Forests, NWFP, Agroforestry)	Continue support to revision and implementation of CF, NWFP and Agroforestry plans
				Support to implementation of FMU management Plan	Support revision of management plans of FMUs and implementation.
				Promote PES as landscape approach to conservation	Promote PES as landscape approach to conservation
				Support community-based cottage scale forest enterprises (NWFP, Wood, Ecotourism)	Continue to promote community-based cottage scale forest enterprises (NWFP, Wood, Ecotourism)
			Develop and implement strategy for optimal utilization of timber resources.	Develop and implement strategy for development of wood-based industries to reduce timber wastage following circular economy concept	Develop and implement strategy for sustainable timber harvesting and utilization
				Promote adoption of efficient and climate smart timber processing technologies to improve wood-based industries	Promote adoption of efficient and climate smart timber processing technologies to improve wood-based industries to

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
				(WBI) to reduce wastage and maximize timber utilization.	reduce wastage and maximize timber utilization.
				Carry out capacity development program in timber processing, wood science and technology.	Carry out capacity development program in timber processing, wood science and technology.
			Promote people-centric biodiversity conservation and improve rural economy through Access and Benefit Sharing (ABS) Programs	Needs assessment in natural product development and market analysis	Develop nature-based products to derive benefits and equitable sharing among rural communities
				Infrastructure development (Lab and equipment's)	
				Promote Access and Benefit Sharing (ABS) regime	Promote Access and Benefit Sharing (ABS) regime
			Enhancing the use of local knowledge and beliefs for the conservation of biodiversity and forest	Documenting the traditional ecological knowledge to establish baseline environmental information.	Raising awareness on the use and importance of indigenous knowledge
		Forest enterprises developed to improve the livelihood of communities and reduce degradation of forests and conservation of biodiversity enhanced	Build technical capacity for Research and development in bioprospecting.	Human resource and infrastructure development. Procurement of laboratory equipment	
				Research on phytochemical analysis and product development	Research on phytochemical analysis and product development
6	Ensure women's and other vulnerable	Increased access to resources and	Develop gender responsive natural	Stakeholder consultation and drafting of framework	Implement gender responsive resources access framework

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
	groups assess to natural resources and capacity building	capacity building	resources access framework.		
			Develop gender responsive capacity building plan	Stakeholder consultation and drafting of capacity building plan	Implement gender responsive capacity building plan

3.1.4 Human Settlements and Climate Smart Cities

With a rapidly urbanising population, climate proofing existing urban areas and other critical infrastructure is essential, as is preparing and implementing strategic plans for urban areas and human settlements. The priorities for the water sector are based on the detailed studies conducted for water in the NAP project, the 1st and 2nd NDCs, the Low Emission Development Strategy for Human Settlements and the Third National Communication. There are great synergies for mitigation and adaptation in urban areas and human settlements as already identified in these documents. For example, energy savings from residential and commercial areas due to energy efficiency and renewable energy generation (solar roofs) reduce the uncertainty of hydropower and function as both adaptation and mitigation measures. Securing ecosystem services in the form of '*green infrastructure*' around and within human settlements are nature-based solutions for both mitigation and adaptation.

The adaptation priorities for human settlements centre around developing climate smart cities and human settlements that leverages green infrastructure and ecosystem-based adaptation. Climate proofing existing critical infrastructure such as roads, bridges, houses, industrial areas, and agricultural infrastructure is also needed. Measures are identified to adapt to increasing floods, landslides, windstorms, and urban heat island effects. Besides hard infrastructure investments, soft interventions like risk assessments, research and data, policies and regulations and preparedness are also identified to enhance climate resilience in human settlements.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
1	Develop climate smart cities and human settlements.	Sustainable and climate resilient human settlements	i) Strengthen institutional and policy environment to enable climate resilient planning and implementation	i) Review existing Guidelines on Planning and Development in Urban and Rural areas of Bhutan to minimize environmental impacts ii) Prepare climate resilient infrastructure master plans. ii) Review Samdrup Jongkhar Urban Development Plan to	Climate-resilient infrastructure development Carry out geotechnical requirements in critical areas to assess any changes in the soil structure.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
				incorporate climate resilient components: to implement the Pilot Project for Climate Resilience (PPCR) activities iii) Carry out geotechnical investigations to facilitate preparation of land use plans iv) Incorporate "build back better" including integration of mitigation priorities, health risk considerations and improving accessibility vi) Ensure operation and maintenance of infrastructure	Carry out periodic reviews. Carry out frequent supervision, upgradation if required including adopting enhanced technologies.
			ii) Leverage "green infrastructure" for ecosystem-based adaptation in urban areas.	i) Assess green infrastructure for ecosystem-based adaptation options for urban areas such as green spaces and buffer zones in line with LEDS for Human Settlements. ii) Prepare Transportation master plan for Thimphu iii) Strengthen implementation of no-build zones on riverbanks, green zones and other water channels with strict rules and regulations through enforcement of existing legislation (EA, Water and FNCA)	Integration and implementation of nature-based solutions in urban management Carry out periodic monitoring
			iii) Combat risk of Urban heat island	i) Implement green infrastructure plan as part of implementation of Thimphu structure plan. ii) Establish green spaces; micro parks, avenue plantation, green building components in urban/town areas. iii) Promote green and resilient building designs in line with LEDS for Human Settlements to reduce urban heat island effect.	
2	Build comprehensive database for urban areas	Comprehensive Geodatabase for housing, infrastructure	Strengthen database for housing, infrastructure	Develop Geodatabase for housing, infrastructure, utilities, recreational areas, and green spaces	Update the database

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
		including utilities, recreational areas and green spaces developed.	and utilities, recreational areas, and green spaces		
3	Enhance logistics preparedness for disaster management and improved service delivery	Enhanced logistics preparedness for disaster management including postal services	Enhance logistics preparedness for disaster management and improved service delivery	i) Develop Geocoded/Street Addressing for the Thromdes ii) Review Disaster Management and Contingency Plan for the construction and human settlement sectors	Update the System Carry out implementation of the action plan
4	Climate proof critical infrastructures and settlements against floods and landslides	Safe, liveable, and resilient infrastructure in critical areas	Provide climate resilient infrastructure in critical areas for disaster risk reduction.	Review and develop flood and storm water management plans and Low Impact Development Plans for urban areas. Review design of Flood protection management protective structures like dams, drainage systems, and barriers in flood-prone areas including in industrial/economic zones.	Implementation of the climate resilient infrastructures, recommended in the flood and stormwater management plans. Monitoring and Evaluation of climate resilient infrastructures for disaster management
			Strengthen windstorm management through capacity building and awareness.	Enhance/improve disaster preparedness through infrastructure, capacity building, awareness and trainings based on Guidelines for Windstorm Resilient Roofing System	
5	Construct climate resilient road infrastructure	Climate proof transport infrastructure	Reduce risk of landslides from increased precipitation in critical zones	Construction of climate resilient road infrastructure Identification and mapping of perennial slope (including debris flow site) Assess landslide risk and develop landslide management plans. Terracing or slope stabilization of landslide prone areas. Slope stabilization along national and Dzongkhag highways.	Introduction and implementation of flood/landslide resilient infrastructures Explore potential for tunnelling to bypass landslide prone areas

3.1.5 HEALTH

Climate impacts on human health are starting to manifest in terms of increasing risks of vector- and water-borne diseases, and direct impacts on lives from climate induced disasters. Other emerging threats that have come to the fore in the light of the COVID-19 pandemic include risk of zoonosis events because of changing wildlife habitats and increasing intersection between wildlife, livestock, and human settlements. In addition to implementing measures to address the various emerging risks on human health from climate change, the adaptation needs in the health sector include enhancing capacity and building resilience of the health infrastructure against climate risks and impacts so that such services can continue during extreme events.

Measures for the health sector include, building resilience of critical public health infrastructure against extreme events and long-term climate risks. Enhancing health emergency preparedness to respond to climate induced disaster and enhancing surveillance and management of climate sensitive and vector borne diseases is needed. Further research and capacity building of the health sector is needed since the topic of climate risk integration is a fairly new topic among health professionals and practitioners in Bhutan. The health sector also depends on cross sectoral collaboration and coordination, since the determinants of health fall on other sectors and agencies, such as through Water, Sanitation and Hygiene (WASH) facilities, design of the living environment and disaster risk reduction and management. In the health sector, stakeholders have identified the participation of senior citizens and retired professionals as partners to fill in gaps in specialised capacity and provide support in outreach and advocacy to vulnerable groups.

	Strategic Objectives	Strategic Outcome	Strategic Action	Short Term activities (0-5yrs)	Medium term activities (5-15yrs)
1	Build resilience of critical public health system and infrastructure against extreme events and long-term climate risks	Improved resilience of health system to climate change	Improve health infrastructure and equipment to adapt to climate change impacts	Strengthen laboratory facilities and monitoring systems for climate sensitive diseases.	-
			Improve access to water supply and sanitation for health facilities	Improve existing Water, Sanitation and Hygiene (WASH) Infrastructures with climate change resilient technology and inclusive accessibility based on the WASH FIT tool assessment	Build new WASH Infrastructures with climate change resilient technology and inclusive accessibility based on the WASH FIT tool assessment
				Strengthen the monitoring mechanism for WASH improvements in HCFs through close collaboration among Royal Center for Disease Control (RCDC), Infection prevention and control (IPC), Quality Assurance and Standardisation Division	Sustain/improve monitoring of WASH facilities in HCF

	Strategic Objectives	Strategic Outcome	Strategic Action	Short Term activities (0-5yrs)	Medium term activities (5-15yrs)
				(QASD) and Anti-Microbial Resistance (AMR)	
				Strengthen waste management system in healthcare facilities and Thromdes to control climate sensitive disease vectors	Continue to improve on waste management at all levels in health facilities and Thromdes to control climate sensitive disease vectors
2	Enhancing health emergency preparedness & response to climate induced disasters	Improved capacity of health facilities to handle climate change induced disasters	Enhance Emergency Preparedness and Response Capacity	Conduct risk assessment of health care facilities for climate change induced disasters	Reduce impact of climate change on health care infrastructure.
				Capacity development on climate induced emergency medical services	Continue Capacity development on climate induced emergency medical services
3	Enhancing surveillance and management of climate sensitive and vector borne diseases	Reduced risk from climate sensitive and vector diseases (malaria, dengue, kala azar etc) on vulnerable populations particularly in warm regions.	Enhance and integrate the existing early warning system for climate sensitive diseases through a surveillance system and prediction model.	Strengthen existing surveillance system.	Develop a vector borne diseases early warning and prediction model
				Develop monitoring framework for prevention and control of climate sensitive diseases	
			Establish International coordination and collaboration in border regions with high-risk cross-border climate sensitive diseases transmission	Cross border collaboration for climate sensitive diseases prevention and control (migrant screening, vector surveillance in project areas, awareness)	Review and sustain cross border collaboration
			Strengthen program capacity for management of climate sensitive and vector borne diseases	Enhance capacity of health workers for management and surveillance of climate sensitive and vector borne diseases	Develop HR capacity for National centre on training and research for climate sensitive diseases
				Establish a national center for training and research on VBDs and zoonoses	Operational research on VBDs
			Strengthen community resilience to VBDs	Develop community capacity for prevention of VBDs in high-risk areas	Review of community participation to develop

	Strategic Objectives	Strategic Outcome	Strategic Action	Short Term activities (0-5yrs)	Medium term activities (5-15yrs)
					sustainable community engagement plan
			Strengthen capacity of health centres for water quality and monitoring to international standards.	Capacity development of pre-service and in-service health workers on water quality monitoring as per international standard	Certification of health centre
4	Building awareness and capacity of the health sector on climate change adaptation	The health sector is sensitised and able to start integrating climate change adaptation in overall health programs and plans	To enhance capacity of health sector to address risks and impacts of climate change on health	Enhance capacity for diagnosis and management of new/emerging climate sensitive diseases)	Continue capacity development for diagnosis and management of new/emerging climate sensitive diseases)
				Training of health workers on climate change adaptation using WHO training modules	Continue same training
				Create awareness to workers and employers of the potential accident and disease risks associated with climate variabilities	-
			Integrate and organised climate change teaching and learning curriculums	CC integrated into existing curriculums. Capacity to handle climate sensitive health issues	Review and update pre-service and in-service curriculums. Enhance parasitology & entomology pre-services training in the KGUMSB Initiate long term training such as Masters' and Ph.D. programs for CC and related health issues
			Improve risk communication on rising trend of emerging and re-emerging infectious diseases on zoonoses (eg. Influenza and COVID-19)	Strengthen disease outbreak investigation and response for prioritized zoonoses issues.	Sustaining activities for the readiness to combat hazard and contain infectious diseases (Emerging and re-emerging infectious diseases).
				Conduct awareness campaigns on risks of increased zoonoses events from human wildlife interface and livestock due to climate change.	
5	Research on impacts of climate	Generated evidence on health	Generate scientific evidence on health and climate change	Conduct climate change related emerging disease burden study in the country	Develop climate Sensitive Diseases(CSD) early

	Strategic Objectives	Strategic Outcome	Strategic Action	Short Term activities (0-5yrs)	Medium term activities (5-15yrs)
	change on human health	impact of climate change for enhanced adaptation to climate change	through targeted research on the impacts of climate change on health and health system in Bhutan		warning and prediction model
				Assess health system vulnerability and adaptation to climate change	Build institutional capacity to adapt to climate change
				Policy review on integration of health in policies of health determining sectors	High level advocacy for integration of health in the policy of health determining sectors
				Assess risk of heat waves and heat stress across different population groups	Develop early warning systems for heat waves and stress

3.1.6 ENERGY

Almost 100% of electricity generation in Bhutan is from Hydropower and is another factor enabling Bhutan to remaining a carbon neutral country. Hydropower development has been a major driver of economic growth and the sales and export of hydropower is a significant source of national revenue. While generation of hydroelectricity is significantly lower in winter, climate change is expected to worsen the situation with projections of drier winters. Increasing intensity of monsoons, increased sedimentation can also increase maintenance costs of hydropower plants, while the risk of GLOF threatens such large investments.

Adaptation measures in energy sector is therefore a two-pronged strategy for climate proofing hydropower investments and diversifying energy sources beyond major hydropower project by developing and scaling up alternative renewable energy programs. These adaptation measures have mitigation co-benefits, but adaptation in the sector is equally important to ensure energy security. The priority measures for hydropower are based on the priorities identified in the technical assessment for water sector as part of the NAP readiness project, 2nd NDC, Third National Communication and the Sustainable Hydropower Development Policy.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
1	Diversification of energy systems to reduce vulnerability of hydropower from climate change	Increased resilience of energy system and energy security and reduced GHG emissions	Pursue Alternative renewable energy program (AREP) consisting of solar, wind, green hydrogen, and waste-to-energy technologies	Assessment and development of green hydrogen roadmap	Implementation from the recommendation of green hydrogen roadmap
				Undertake Alternative renewable energy projects: - Rooftop Solar PV in rural areas - Renewable Energy for Climate Resilience (Phase-I)	Implement rooftop solar PV at consumer's premises and development of prosumer market.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
				Promoting Energy Security and Transition Project	Renewable Energy for Climate Resilience (Phase-II)
				Decentralised RE Systems	Implement waste to energy plant. Install Solar Water Heating System
			2.Implement and scale up of energy efficiency programs in the energy intensive sectors	Development of Energy Information System	
				Implementation of Standards and Labelling scheme Development of energy efficiency codes of practice for Building Implementation of energy efficiency codes of practice for industries	Development of Minimum Energy Performance Standards (MEPs)
				Certification of energy professional as energy auditors	Certification of Energy Efficiency buildings Strengthening of Electrical testing laboratory
				Study on investment opportunities for energy efficiency projects	
			3. Assess and incorporate climate resilient energy technologies and power system infrastructure	Assess and Incorporate climate resilient energy technologies and power systems infrastructures.	Undertake research and development of emerging energy technologies.
2	Increased resilience of hydropower infrastructures/technologies to climate change.	Resilient infrastructure with limited exposure and reduced vulnerability.	Review designs and increase capacity of hydropower projects to improve resilience	Undertake Feasibility Study of a Pumped Storage scheme and DPR update of reservoir type hydropower project	Development of a Pumped Storage Power Plant (PSPP) and reservoir type hydropower projects
				Investment planning and financing for 404 MW Nyera Amari-I&II Integrated Hydropower Project;	i) Construction of Nyera Amari-I&II Integrated HPP;
				ii) Feasibility study of Begana Integrated Multipurpose Small Hydropower Projects (IMSHP) for power	ii) Construction of Begana IMSHP

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
				generation & supply of drinking & irrigation water	

3.1.7 Climate Services and Disaster Risk Reduction

Priorities under climate services and disaster risk reduction is considered a cross cutting issue that affects all sectors. The challenging mountainous environment of Bhutan with tremendous variation in topography creates challenges for providing weather and climate forecast and early warning services. Greater enhancement of climate studies including hydrological studies, improvements in climate projections and better early warning systems is a critical need. Climate induced disasters will also affect all sectors of the economy, society and particularly the vulnerable groups. While floods, landslides and forest fires are familiar climate induced hazards in Bhutan that are increasing in intensity and frequency, the increasingly erratic nature of monsoon onset and retreat threatens farmers and food security.

Therefore, the key stakeholders in leading these interventions range from NCHM, Department of Agriculture and Department of Local Governance and Disaster Management, in collaboration with all relevant stakeholders. The adaptation priorities for climate services and disaster risk reduction, focus on improving hydrological services for water resources management, strengthening of agro-met services and climate information system, and improvements for efficient flood forecasting and preparedness. Interventions to protect critical infrastructure and settlements also requires improved flood forecasting and preparedness and response systems, along with enhanced early warning, response, and recovery capacity.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
1	Improve hydrological services for water resources management.	Adaptive capacity enhanced through robust water resources planning.	Real-time monitoring and forecasting of the flows. Climate smart water management system.	Comprehensive water resource assessment, with geo-tagging and monitoring plan. Expand and improve hydro-meteorological stations to include tributaries. Efficient database and information dissemination system on hydrometeorology. Enhance seasonal and annual weather forecasts to generate hydrological flow forecasts. Enhance hydrological Modelling and simulation for water resource forecasting	State-of-art River monitoring and forecasting with decision support systems.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
2	Strengthen agro-met services and climate information system.	Enhanced adaptive capacity of farmers	Provide climate related agro advisories services.	Operationalise the generation of agromet advisory services. Establish end-to-end channels of dissemination of weather and climate advisories *(media, SMS, community network etc.)*	Improve accuracy
				Develop a grassroots advocacy program on early warning preparedness for farmers and communities on extreme events and seasonal risks	
			Innovation/ research on agro-met using real time climate data.	Research on changes in crop phenology Crop suitability studies	Continue research
3	Protect critical infrastructures and settlements.	Safe, liveable, and resilient infrastructure in critical areas for flood/landslide protection	Improved/efficient flood forecasting, preparedness, and response system.	Modelling and forecasting of extreme weather events and dissemination of information to the LGs and other sectors installation of additional early warning systems at critical areas Map and target flood prone areas with specific, action-oriented communication before, during and after the flood events.	Enhance flood forecasting, and hazard and risk mapping.
4	Enhanced early warning, and response & recovery capacity	Reduced vulnerability to disasters.	Monitoring of PDGL, glaciers, snow.	Expand and improve existing early warning systems for GLOFs and other hazards	Glaciers and snow (hydrological) modelling and forecasting. Strengthen assessment studies to monitor snow and glaciers.
			Comprehensive Disaster Management & Contingency Plans (DM & CP) produced and implemented	Review and update DM and CP.	Implement programs and activities under the DM and CP

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)
			Preparedness for disaster response. Enhance awareness of communities on water related hazards (GLOF, Floods)	Ensure relief funds (and other mechanisms e.g., insurance) for fast repair and recovery of properties and infrastructures and to compensate for damages are in place. Conduct flood simulation exercises to improve the preparedness level of the community (Enabling action) Conduct awareness program on water related hazards at the community level (Enabling action) Incorporate build back better (replacement with climate resilient infrastructures) Ensure operation and maintenance of infrastructure (aimed at fast recovery).	Assessing the community preparedness towards flood and water related disasters.
			Flood forecasting and monitoring improved. Build preparedness through adoption of early warning systems, forecast models, and data management.	Ensure timely and effective early warnings issued to the downstream communities. Develop Contingency plans and install Early Warning Systems with real time monitoring.	Ensure timely and effective early warnings issued to the downstream communities.

3.2 Enabling Activities

A conducive and supportive enabling environment for adaptation planning and implementation is required to due to the long-term frame of climate change and its impacts spanning several decades. Enabling actions are required to support (i) the implementation of the priority adaptation actions and (ii) the NAP process that is progressive, continuous, and iterative.

The first NAP was developed as part of a readiness support from the GCF, which included support for enhancing existing institutional and technical elements for the NAP process in Bhutan. As the NAP process is a continuous and long-term process, support for enabling activities will need to be continued in the long term in a variety of ways ranging from domestic policy and institutional support to international financial and technical support.

The enabling actions are organised in five clusters and build on existing measures and recent climate initiatives including the NAP readiness support. These measures are intended to enhance the enabling environment as part of "laying the groundwork" for supporting the NAP process in Bhutan.

3.2.1 Policy and institutional

To ensure NAP process for the long term, some of the key enabling activities are strengthening the policy and institutional environment. Key priorities included enhancing institutional capacity to facilitate the integration of adaptation planning and implementation at all levels from national to local government institutions (vertical integration). A review of all relevant policies and legislation is also identified to ensure coherent climate action. Enhancing and building on ongoing efforts to ensure collaboration and coordination of adaptation among they many stakeholders across sectors and different levels is also a priority to minimise overlaps, duplications, and avoidance of maladaptation (horizontal integration). Civil society and the private sector are identified as partners for adaptation and the enhancement of their engagement and capacity is a priority to support the NAP process.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)
1	Enhance institutional capacity to address national adaptation needs	Adaptive capacity enhanced through mainstreaming of adaptation	Facilitate establishment of CC units at all relevant agencies (core group led by a coordinator within each relevant agency) *(* Recommendation from (i) NAP Stock Taking Plan and NAP consultations) & (ii) Consultations for CBIT project)*	Develop TOR and mandates and identify climate change units in line with CC policy and NEPA 2007 Institute CC units in national agencies	Regular functioning and support for E/CC units.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)
			Enhance Environment Units at Dzongkhag level to take on climate change issues	Develop TOR and mandates for climate change units in line with CC policy and NEPA 2007 and LG Act, and of Gender, Environment, Climate, Disaster, Poverty (GECDP)	Regular functioning and support for E/CC units.
2	Strengthen national policies and legislation to enhance climate change action	Enhanced implementation and enforcement of climate change resilience actions	Review and revise policies and legislation for gaps and opportunities in effective integration and implementation of climate action.	Review all relevant policies and legislation for integration of climate change action in line with CC Policy for effective integration and implementation of NAPs, NDCs and other sectoral strategies	Revise and update policies and legislation as appropriate to enhance integration of climate change action including adaptation.
3	Enhance coordination of climate change adaptation	Coherent and coordinated national adaptation planning and implementation	Enhance capacity of key institutions and drivers for coordination of climate change action in Bhutan	Strengthen the Secretariat (CCD/NECS) in supporting the NCCC (HR, training, resources) Regular briefings to NCCC on CC Adaptation and NAP process as necessary. Annual review on NAP process by NCCC (based on C4 reports)	Continuous briefing and training on continuous basis for changing membership
				Capacity building of Climate change Coordination Committee (C4) for its mandate on adaptation (Capacity building of members of C4) Review progress in NAP process covered in meetings of the NCCC	Continuous awareness, briefing and training on continuous basis for changing membership. Review progress in NAP process covered in meetings of the NCCC
				Enhance One Health Initiative of MoH to include other sectors for climate change priorities in NAP	Continued engagement

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)
			Ensure continued support and improvement in knowledge management and collaboration for NAP process through the Bhutan Climate Platform (BCP).	Continuous enhancement and maintenance of Bhutan Climate Platform to support NAP process Trainings for new collaborators and refresher for focal persons	Review and enhancements as needed. Refresher training and updates for collaborators of BCP
4	Ensuring active and meaningful and inclusive engagement & collaboration of CSOs and private sector in implementation of the NAP	Holistic and inclusive adaptation planning and implementation in Bhutan	Regular engagement with CSOs and the private sector on NAP process and adaptation implementation	Annual dialogue on climate change adaptation between policy makers, academia, private sector, and civil society Engagement of CSOs and private sector in NAP implementation as per respective roles identified in adaptation priorities and implementation strategy. Review and adapt Stakeholder Engagement Plan (SEP)[9] including broader participation from academia, civil society, and private sector	Continuous M&E awareness. Review & update stakeholder engagement plan in NAP process.

3.2.2 M&E OF NAP PROCESS

As discussed in Chapter 5 on M&E a robust M&E system is identified as a key requirement to ensure that adaptation plans and priorities are implemented at all levels and by all key stakeholders and that intended objectives are being met. The M&E system for the NAP process in Bhutan covers three levels of processes (i) monitoring progress in the implementation of this NAP document (ii) establishing a national system to measurements of resilience and vulnerability at a higher level (iii) developing and building a national M&E system that not only supports national requirements in line with the Climate Change policy, but also supports international reporting requirements under the Enhanced Transparency Framework of the Paris Agreement.

[9] Stakeholder Engagement Plan for NAP, NAP Readiness Project, NEC/UNDP, 1 April 2020

All the proposed M&E systems are intended to build on any existing national M&E and reporting systems and other sector level M&E frameworks such as the Bhutan Water Security Index. The M&E process also includes the processes for taking stock of the iterative NAP cycle and processes for preparation of the 2nd NAP for Bhutan.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)
1	Establish and integrate a monitoring and evaluation system for adaptation in line with CC policy	Bhutan's resilience to climate change enhanced through an effective and efficient NAP process	Track and monitor the progress in implementation of the first NAP (this document)	Prepare annual progress report on implementation of the NAP Capture best practices and lessons learned (BOPLL) in implementation of the NAP Prepare 2nd NAP in an iterative manner	NAP Process reviewed and enhanced including preparation and implementation of subsequent NAPs in an iterative manner.
			Establish a national monitoring system to assess progress in adaptation including measurements of resilience and vulnerability to climate change in line with the CC policy 2020	Review and enhance the approach in *"Climate Change vulnerability analyses and mapping for NAP formulation process in Bhutan"* for measuring vulnerability & adaptive capacity at a national level and across sub-national levels of dzongkhags and gewogs. Develop a tool for assessing adaptive capacity and vulnerability to climate change to assist planners and practitioners for planning and implementation of adaptation projects and programs. Develop and implement training on M&E for adaptation	National system to monitor progress in adaptation implementation & tracking of adaptive capacity and resilience made operational.
			Develop and implement a NAP M&E system, that is responsive to reporting requirements of the CC policy and the Enhanced Transparency Framework under UNFCCC & Paris Agreement	Establish a national monitoring and tracking system to report on *"support received"* for climate change actions (mitigation and adaptation) for the Biennial Transparency Reports (BTR) by assessing and building on existing national monitoring systems. Assess and prepare a report on the Progress, Effectiveness	Implement and iteratively improve M&E system.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)
				and Gaps (PEG)[10] on NAP process by year 3 of NAP implementation program.	
			Develop sector level M&E frameworks for critical sectors	Set up an M&E framework for the water sector along the lines of the Bhutan Water Security Index (BWSI).	Implement the M&E framework along with BWSI.

3.2.3 RESEARCH AND DATA

Informed decision making and planning for adaptation with the best available science has been strongly recommended for the NAP process in the UNFCCC's NAP guidelines and through the consultations. In this regard, the research and data will be developed by implementing the "*Roadmap and Strategy for Strengthening Climate Change Research in Bhutan, 2020*". The priorities cover three main areas of interventions (i) Conducting specific needs-based research for the different sectors and stakeholders. (ii) dissemination of the results and information through the Bhutan Climate Platform and through education and outreach programs (ii) strengthening research for climate change adaptation in Bhutan through institutional strengthening and enhancing the Bhutan Science Foundation.

This climate research roadmap is led by the Royal University of Bhutan through its associated institutions and other collaborating agencies. Also see Annex 4 for further details on the prioritised research topics identified as need-based research for climate change adaptation through "Strategic Imperative I: Tackle issues which matter" under the "Roadmap and Strategy for Strengthening Climate Change Research in Bhutan, 2020".

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)
1	Enhance climate change action through informed planning and implementation by implementing the Roadmap and Strategy for Strengthening Climate Change	Adaptation planning and implementation in Bhutan is enhanced by the best available science in a coherent and sustainable manner	Conduct policy-relevant and need-based research for climate change adaptation through "*Strategic Imperative I: Tackle issues which matter*"	Assess the risks and impacts of climate change on food production systems. Conduct targeted research for forest fire risk management. Conduct research and document changes in biodiversity including on species and habitats, and other drivers of degradation and loss.	Review Climate Research Roadmap and prioritise next set of research to inform NAP process

[10] The PEG Tool of LDC Expert Group of the UNFCCC is designed to assess effectiveness of NAP process by reviewing ten essential functions of the NAP process.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)
	Research in Bhutan (2020)			Research on climate induced issues such as HWC and drivers of forest and biodiversity loss Research and document type of pests and diseases affecting wildlife and plants. Conduct studies water including on trends and impacts, management, technologies, and water related disasters. Research and assessments to support diversification of energy sources considering vulnerability of hydropower. Research on economic impacts of climate change, critical infrastructure & human settlements, private sector Assessment on ecosystem/nature-based approaches for adaptation Assess opportunities for cross cutting issues and gender integration. Research and economic assessments to support diversification and resilience of private sector	
			Disseminate and increase awareness of climate change research to inform adaptation planning in Bhutan and further through strategic imperatives III and IV of the Roadmap	Integrate a "Climate Research, Information, and Service Portal" (CRISP) *(Strategic Imperative III)* into the Bhutan Climate Portal (BCP) Mainstream and strengthen pedagogy, outreach, and capacity building *(Strategic Imperative IV) (Linked to Enabling activity E)*	
			Strengthen and build sustainability of climate change research to support the NAP process	Strengthen institutions and networks, inspire leaders, and empower researchers (Strategic Imperative II)	Update the Climate Research Roadmap

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)
			for through strategic imperatives II & V and update of the roadmap.	Establish the "Bhutan Science Foundation" *(Strategic Imperative V)*	

3.2.4 Capacity Building

Continuing capacity building is required to ensure that new actors can be effective adaptation planners and implementers, while skills and capacity will need to be upgraded for others with continually emerging new findings, methodologies, and techniques for adaptation practice. While some level of targeted capacity building has been included in the sectoral and thematic adaptation priorities, overall capacity building for the NAP process is based on the "*Skills Assessment for the NAP Process in Bhutan (SANP) 2020*". To fill the gaps and needs identified in the SANP, the priorities include (i) integration of climate change adaptation learning into the national education and training systems (ii) developing an institutional memory for climate change adaptation by building cohorts of training of trainers and modules in relevant institutions. (ii) promoting the awareness and utilization of indigenous/ traditional knowledge systems and (iv) ensuring sustainability with a financial strategy to sustain climate change skills development.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)
	Address capacity gaps and needs for the NAP process as per the "*Skills Assessment for the NAP Process in Bhutan* (SANP)"	Effective and locally led adaptation planning and implementation by key stakeholders and sectors	Capacity Building on adaptation learning program into the national education and training systems *(Strategy 1 of SANP)*	Development of climate change learning module and curriculum Vocational Education Curriculum Development for Climate Mitigation and Adaptation Creating awareness for students and their parents to understand climate change adaptation as a career option	Update the Skill Assessment and capacity Needs
			Develop institutional memory for climate change adaptation *(Strategy 2 of SANP)*	Training of Trainer (TOT) programs and development of training modules at RUB and RIM	
			Promote integration of awareness and utilization of	Strengthen linkages with government, academia, and extension capacity of NGOs and CSOs operating in natural	

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)
			indigenous/ traditional knowledge systems *(Strategy 3 of SANP)*	resource management/agriculture space. Develop and implement a public sensitization program on IKS across the community level. Develop a repository of all traditional and Indigenous knowledge systems. Mainstream IKS in development projects.	
			Develop financial mechanisms to sustain climate change skills development *(Strategy 4 of SANP)*	Develop financing strategy for capacity building. Mainstream climate change capacity development in sectoral and local budgets	

3.2.5 Education and Awareness

As elaborated in the chapter 4 (Implementation Strategies), education and awareness for key stakeholders along with awareness about climate change and adaptation among the public is critical to ensure buy- in and support for the NAP process. The strategy for this priority includes (i) integration of climate change adaptation into education curriculum (ii) enhancing the skills pool for climate change adaptation planning and research through targeted scholarships (iv) conducting advocacy campaigns on climate change adaptation, preparedness, and early warning as part of the communication strategy. Key partners in education and awareness include CSOs, the media and media production houses from the private sector.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)
	Enhance education and awareness on climate change adaptation	Awareness and understanding of climate change risks and adaptation among the wider	Integrate climate change adaptation into education curriculum	Review and integrate climate change and adaptation into education curriculum in a comprehensive and holistic manner at appropriate levels[11] a. Update information on CC for already integrated curriculum (higher levels)	Review and update

[11] See the report *"The Heat is on! Towards a Climate Resilient Education System in Bhutan",* UNICEF, 2022

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)
		population for more effective collaboration and individual actions.		b. Refreshers and training for teachers c. Fill gaps in lower level by activity or other modes (clubs, activities, scouts, exploratory)	
			Enhance the skills pool for climate change adaptation planning and research through targeted scholarships	Provide scholarships for specialised trainings for key course based on Skills Assessment Plan	
			Conduct advocacy campaigns on climate change adaptation, preparedness, and early warning as part of the communication strategy for NAP in Chapter 4.	Targeted training advocacy for (policy makers, planners, and practitioners) on CC adaptation planning and implementation and integration through climate training programs and training of trainer programs	Review and refresher courses
				AV products for broadcast, print and online/social media developed and delivered.	Review and update
				Develop and conduct grassroots advocacy program on climate risks and adaptation, particularly for vulnerable communities and groups	Review and update

4. Implementation Strategy

The implementation of the NAP is guided by the Climate Change Policy which recognises that climate change is a cross cutting issue that affects all sectors and stakeholders. This approach is in line with the principles for environmental stewardship and the middle path approach to development in the Constitution and various environmental legislation as discussed in Chapter 1 on policy alignment. The Climate Change Policy calls for integration, synergies and an inclusive approach for implementation and all sectors and stakeholders at all levels in Bhutan to undertake appropriate action on climate change.

In implementing the NAP, both adaptation priorities across key sectors and enabling actions will be implemented. The priorities with concrete adaptation programs and activities are mentioned in Chapter 3 and the soft components (enabling activities) to support the NAP process to ensure that adaptation in the long run is sustained and responsive to the changing risks and needs in the medium to long run.

On an operational level, government agencies will have to first integrate climate change actions identified in the NAP and NDC into national plans and programs in line with national procedures for planning and budgeting before any steps towards financing can be taken. In this regard, this chapter identifies the possible entry points to integrate the adaptation priorities into national and local development plans. Several approaches to integrate the numerous adaptation priorities in a holistic and programmatic approach are also identified as possible options for future five-year development plans or other thematic and sectoral development plans. While subsequent financing of the plans follows integration into national plans, potential sources for climate financing from multilateral and bilateral channels have been presented in addition to innovative national mechanisms.

For the NAP to be successfully implemented, concerted communication and outreach effort is essential to build awareness and support for integration of adaptation into national plans that will contain other economic and development priorities The roles of key agencies and stakeholders in leading, facilitating, implementing, and financing of the NAP are also presented in this Chapter.

4.1 Integration of NAP into development Planning

In line with the Climate Change Policy, the primary mode of implementation of the NAP will be through the integration of adaptation priorities into national and local development plans. The lead responsibility for integration of NAPs and NDCS is on the NEC, MoF, and the OCASC. The private sector and civil society will be engaged as partners for implementing climate change priorities based on needs and comparative advantages.

In integrating the adaptation priorities into national and local development plans, several key points need to be considered:

i) the appropriate entry points for integration need to be identified.
ii) the implementation of the NAP should be inclusive from national to local levels including the most vulnerable communities, civil society, and the private sector.
iii) Maladaptation should be avoided by considering all available information in planning and implementation of activities.

4.1.1 Entry Points for integration of adaptation into development plans

Five Year Development Plans

The primary entry point for the NAP into development planning will be through the five-year development plans (FYP). The 12th FYP (2018-2023) with the theme of *"Just, Harmonious and Sustainable Society through enhanced Decentralization"* had integrated climate change as one of the sixteen National Key Result Areas (NRKA) and facilitated the implementation of climate change adaptation and mitigation in line with some of the priorities in the NAPA, 1st NDC and Low Emission Development Strategies.

The 13th FYP is for the period 2024-2029 has the main objective of *"A Dynamic, Prosperous, Inclusive and Sustainable Economy in Pursuit of GNH"* and it is expected that cross cutting themes of environment, climate change, disaster, gender, disability, elderly citizens, and poverty will be mainstreamed in the policies and plan for integrated implementation, holistic and sustainable developmental outcomes. The decentralization efforts in recent years will also continue with the capacity building of local governments in development planning and management and in "locally led climate change adaptation". The 13th FYP is also expected to have components that cover both projects implemented within a 5-year period and long-term projects for key infrastructure, economic centers and energy programs that can span more than five years[12]. This new approach will allow for easier integration of long-term adaptation planning and implementation.

National Economic Development Plans

Other key entry points include strategic national documents such as the *"21st Century Economic Roadmap"* and other high-level exercises such as the "*Transformation Initiatives*" and plans and programs for economic recovery after the COVID-19 Pandemic and National Disaster Risk Management strategies (see Box 4). These plans for economic recovery and development will need to integrate strategies for resilience not just to threats from biological pandemics, economic shocks, but also climate risks and vulnerabilities. The strategic priorities for adaptation in the NAP will need to be integrated to make the economic plans climate resilient to the expected adverse impacts in the coming decades.

Sectoral Policies and Strategies.

Several sectoral policies and strategies have direct relevance for climate action with several already integrating climate change adaptation and climate resilience such as the Sectoral Adaptation Program of Action 2016 (Agriculture) and National Forest Policy 2011, National Disaster Risk Management Strategy 2017, National Human Settlement Policy 2019, National Construction Industry Policy 2020, National Housing Policy 2020, National Sanitation and Hygiene Policy 2020, Sustainable Hydropower Development Policy 2021, Renewable Natural Resources Strategy 2030 (draft 2022), National Health Policy.

[12] Draft Concept Note for the 13th Five Year Plan (FYP 2024-29), GNHC 2022

Bhutan's Long-Term Low Greenhouse Gas Emission and Climate Resilient Development

"Bhutan's Long-Term Low Greenhouse Gas Emission and Climate Resilient Development Strategy" (LTS) is currently being drafted in response to Article 4, paragraph 19 of the Paris Agreement for Parties to develop strategies towards achieving goals of the Agreement by 2050. The LTS is being drafted with the objectives of guiding Bhutan's objective of remaining carbon neutral through a low emission and climate resilient development pathway. It will recommend low emission strategies in industry, food security, human settlements, surface transport, waste management, energy security and protection of carbon sinks. The LTS also aims to build resilience to climate change impacts and risks by mainstreaming adaptation in development plans.

A key feature of the LTS is to integrate economic development and climate change by developing and implementing an effective climate action plan with the object of decoupling GHG emission from economic growth and building climate resilience while ensuring socially fair transition, cost-effectiveness, creation of green jobs, diversification of economy and enhancing of gross national happiness remains the main driving forces. In this respect, the LTS will serve as an overarching guide for subsequent NDCs and NAPs.

Regional plans development in for rural and urban areas

Other key entry points include major infrastructure and urban development strategies in Bhutan through the implementation of the *Comprehensive National Development Plan (CNDP) 2030*. The recently established Royal Commission for Urban Development (RCUD) has initiated the preparation of a *Regional Strategy and Framework for the National Capital Region,* comprising the major areas from the dzongkhags (districts) of Thimphu, Paro and Punakha/Wangdue and the revision of the Thimphu Structure Plan. The objectives of this strategic assessment and planning already include the reduction of vulnerabilities to the impacts of climate change and has the potential to bring about transformative changes. Bhutan has one of the highest rates of urbanisation in Asia, and Thimphu is the largest city in Bhutan. Thimphu and the surrounding regions of Paro and Punakha/Wangdue is expected to become a major urban region as the national capital region and the integration of climate change for ensuring climate resilient and low emission development. Similarly, the implementation of the *Comprehensive National Development Plan (CNDP) 2030* by the MoIT will focus on the *South-Central Regional Plan* along the Sarpang-Gelephu corridor.

National Standards and Guidelines

An often overlooked but critical entry points for many sustainability and environmental actions are the national standards and guidelines that define infrastructure development practices and fiscal incentives and tax codes that affect economic behaviour. While many strategies, plans and policies are drafted, these standards and codes determine whether intended changes and interventions are realised in practice. Some of the key standards and guidelines of relevance in Bhutan are:

- ***Fiscal incentives*** such as the Fiscal Incentives Act of 2017 and 2021 and the respective rules provide incentives to stimulate economic growth and through the level of import duty and sales taxes affect decisions of private investments in priority areas, technologies, and practices.
- ***Bhutan Schedule of Rates*** (BSR) defines the projecting costs for construction projects and listing of materials and practices defines de-facto practices in civil engineering projects.

- Environmental and Social (E&S) Risk Management guidelines in financial services will enable financial service providers to assess their environment and social risk exposure in lending and decision making under increasing risks of climate change impacts. The Royal Monetary Authority intends to introduce such guidelines as part of Druk Ngudrel Lamtoen 2030[13].
- Procurement Rules and Regulations determines government purchasing of services and goods. As the government is still the major economic actor in Bhutan and major client for purchases and infrastructure investments in Bhutan, sustainable consumption and production practices including climate resilient services can be determined by the Procurement Rules and Regulations and the Standard Bidding Documents.

Box 4: National transformative initiatives and implications for low emission and climate resilient development

Redefining national economic development approaches.

In the past decades, national strategies such as "The Middle Path: National Environment Strategy (1998) and the Bhutan 2020: A Vision for Peace, Prosperity and Happiness (1999) played a pivotal role in defining the approach to sustainable development in Bhutan. Now as Bhutan is poised to graduate from LDC status, a couple of initiatives have been launched to define the socio-economic development pathway for the country facing new economic, environmental, and social challenges.

High level macro-economic plans and strategies such as the "*21st Century Economic Roadmap*" and "Transformation Initiatives" are under development to chart a vision to transform economic development in Bhutan for the coming decades. The 21st Century Roadmap has the objective to "chart out a clear economic roadmap for the 21st century–this will help every Bhutanese and entity to understand their respective roles and work towards a common national objective". The Transformation Initiatives is reported to be an investment program worth Nu. 45 billion and includes a "set of programmes designed to lay a strong foundation to bring about economic transformation and are expected to maintain the macroeconomic stability of Bhutan as a developed country".

Since long-term economic investments will lock in major financial and infrastructure investments, they are also opportunities for a 21st century economy that build on the challenges and opportunities of climate change. Low emission development technologies and economic activities can contribute to the carbon neutral goals for Bhutan and ensure that economic and development investments are responsive and resilient to the current and future risks of adverse impacts of climate change.

The two national economic strategies will result in economic and fiscal policies that can lock in major investments that can facilitate low emission climate resilient development. Conversely if climate change action is not integrated in these strategies, resulting investments may lock in investments that are not aligned to carbon neutral goals, or also more worryingly, result in investments that lead to maladaptation and threaten local populations in the future.

Similarly, "*Bhutan's Long-Term Low Greenhouse Gas Emission and Climate Resilient Development Strategy"* (LTS) is being concurrently being drafted to guide a long-term approach to climate action in Bhutan until 2050. It is critical that the LTS, NDCs and NAP are integrated into the new economic transformation exercise and strategies. However, as of date, it is not known in what direction the 21st Century Economic Roadmap and the Transformative Initiatives are proceeding since drafts of the two strategies were not available for reference or review during the drafting and consultation process for the NAP.

[13] Druk Ngudrel Lamtoen-2030: A Roadmap for a Progressive, Agile, and Resilient Central Bank Enabling Bhutan's Economic Transformation, Royal Monetary Authority of Bhutan, August 2021

Source:
https://economicroadmap.gnhc.gov.bt/
https://kuenselonline.com/nu-45b-worth-of-transformation-initiatives-begin/

4.1.2 ENSURING AN INCLUSIVE NAP IMPLEMENTATION

The adaptation priorities and programs are based on the climate risk assessment across all sectors and regions as described in chapter 2 and 3. In implementing the NAP it will be important to ensure that all vulnerable regions and communities are included. Implementation of adaptation priorities need to expand beyond programs and projects implemented by national and sectoral agencies to locally led programs and other non-government stakeholders.

Local governments

The early adaptation projects in Bhutan were largely infrastructure focused investments to reduce vulnerabilities from immediate threats such as glacial lake outburst floods (GLOF) or other climate induced disasters such as floods, landslides, and forest fires. Locally led adaptation programs were gradually introduced in the 2nd and 3rd NAPA projects.

The thrust of the FYPs for locally led development plans will continue in the 13th FYP and will also increase the locally led adaptation planning. Locally led adaptation planning has piloted and scaled up under the LoCAL program *(Local Climate Adaptive Living Facility in Bhutan: Mainstreaming Climate Adaptation through Local Governance System)* as result-based financing for adaptation through local governments to cover all 205 gewogs in Bhutan. This facility should be utilised as an entry point for climate adaptation planning for local governments.

The results of the *"Climate Change Vulnerability Analyses and Mapping for NAP Formulation Process in Bhutan"* prepared as part of the NAP Readiness project can also inform the OCASC, MoF, local governments and partners in resource allocation based on ranking of regional and vulnerabilities at the dzongkhag and gewog levels.

Vulnerable groups and communities

In addition to local governments, many civil society organisations are also engaged in improving livelihoods and resilience of vulnerable communities and groups including persons with disabilities (PWDs), senior citizens and gender identities. Such organisations working at the grassroots level and vulnerable groups are well placed to act as partners and implementers based on their comparative advantages.

During the consultations CSO groups identified how they can be partners in the NAP process:

- Speak for the vulnerable groups and communities and ensure their inclusion in adaptation plans and priorities, and during implementation of these plans. This would provide a balance to the normally technical and economy focus outputs and priorities from government technical working groups.
- Even vulnerable groups can support adaptation. Senior citizens can also be partners since many members of the Royal Society for Senior Citizens (RSSC) include highly qualified retired civil servants, specialists, and former leaders, with years of wisdom, experience, and knowledge.
- CSOs can be effective partners for advocacy as they have close and direct access to target populations.

- CSOs can also be part of research and monitoring and evaluation as there are also CSOs, and MBOs engaged in these activities.

Private sector

While public expenditure has been the primary driver for economic growth, the government is increasingly recognising the role of the private sector in economic development. The initiatives for stimulating development of the private sector under the Economic Development Policies and incentives will continue. In the 13th FYP, the government aims to engage the private sector and CSOs in harnessing their potential and partnerships and identifying investment areas/resources of the private sector. In this regard, the private sector can also be partners in implementation of adaptation (see text box 5) and areas of potential collaboration has been identified in the adaptation priorities in chapter 3.

Box 5: Engaging the private sector in adaptation.

Private sector and sustainable development in Bhutan

The public sector has long been the primary source of economic growth in Bhutan, but the government has over the recent years placed more significance on the role of the private sector. Economic diversification is a high priority, and the economic policies and fiscal incentives in recent years have provided measures in line with "Brand Bhutan" to stimulate economic growth, foster private sector development, and generate employment. Incentives were also provided to adopt modern environmentally friendly technologies, energy efficiency, renewable energy generation and for waste management and recycling.

These incentives and measures for the private sector vis-à-vis climate action in Bhutan so far have largely been focused on promoting low emission development, but the private sector also has several roles in building resilience and reducing vulnerability. Active participation can lead to good results as was demonstrated during the preparation of the NAPA. The Association of Bhutanese Industries highlighted the threats from increasing floods and landslides in key economic investments such as the industrial estate in Pasakha and lead to interventions on a co-financing basis for remedial measures in critically identified locations.

Role of private sector in Adaptation

The private sector can participate in adaptation in several ways:

Adapt to climate change:

- Businesses, companies, and individual investors also must adapt to climate change. Private investments should be climate proofed against increasing risks and investors must make climate smart decisions to avoid maladaptation and exposing their investments to unnecessary risks.

Finance adaptation:

- The private sector could also be a source of financing and lending for adaptation.
- Financial institutions can channel climate financing from GCF and other sources.
- Social and environmental risk management, in line with the RMA's green financing guidelines, such as insurance schemes and lending policies can ensure climate smart investments and prevent maladaptation in areas with high climate risks.
- CSR initiatives from companies and businesses could support activities to build resilience in grassroot and vulnerable communities.

Provide adaptation services:

- Businesses can provide adaptation services and products on a commercial basis to other businesses.

- They can also implement the works under adaptation projects of national and local government agencies.

Key messages from the consultations with the private sector

1) In preparing the NAP, representatives of the private sector were included in the consultations for the identification of priorities in a bottom-up manner and in the review of the various stages of the drafts. Some of the key inputs from the consultations are:
2) The private sector is keen to participate in adaptation to climate change, but requires the policy, institutional support, and incentives to do so.
3) Capacity building and awareness is also necessary for the private sector to understand the risks and opportunities from climate change.
4) Fiscal and non-fiscal measures are good ways for encouraging participation and investments by the private sector.
5) Concessional financing for investments in climate action by the private sector through national channels will be beneficial, given the lack of financing for green activities in the country. The RMA's initiatives for Green Financing through the financial institutes can be game changing and transformative.
6) Clear standards, guidelines and certifications can provide incentives besides regulations. Self-monitoring and reporting through accredited agencies and associations can be an option besides traditional regulatory monitoring.
7) There is need for better coordination and information sharing on policies and plans among government agencies and with the private sector. Sometimes there are conflicting or incomplete regulatory processes that can stymie initiatives and investments for the private sector.
8) Private sector also sees more opportunities to provide goods and services in areas that were traditionally in the public service delivery. Some of the examples are in delivery of information, data and communication services for environmental and climate projects, along with development or distribution of new products and technologies.

4.1.3 Avoiding Maladaptation

Maladaptation is defined by the IPCC as "*actions, or inaction that may lead to increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future*". Maladaptation results from poor planning or implementation of actions and often from actions that focus on sectors and risks in isolation and on short term gains without considering long term adaptation requirements. Maladaptation may have been 'avoidable' when available information is not used properly, or 'unavoidable' when decisions made with the best available information may turn out to be wrong.

One of the goals of the CC policy is to ensure coordination and coherence in climate action in Bhutan and coordination of efforts. A lack of coordination and information sharing has been one of the key barriers highlighted in the NAP consultations. All relevant agencies must ensure coordination and sharing of information to avoid maladaptation and minimise wastage of limited public resources for development activities that may lead to greater future risks. This important issue is discussed further in text box 6.

Box 6: Avoiding maladaptation in Bhutan.

Examples of maladaptation in Bhutan

The most common climate hazards in Bhutan are flash floods and landslides, and glacial lake outburst floods (GLOF) are also high-risk high damage hazards. In this regard, several examples of maladaptation in Bhutan include (i) building settlements and roads in areas along riversides designated as red zones for flash floods and or GLOFs, or (ii) filling in river and stream buffers in urban settlements such as Thimphu while ignoring the fact that surface runoff is increasing with increasing intensity of rainfalls.

Causes of maladaptation

Poor coordination and lack of information or limited sharing of existing information is attributed to decisions and plans that are made without considering critical and relevant information to avoid maladaptation.

Solutions

To avoid maladaptation, several measures are required:

Awareness outreach and advocacy to development planners and regulators at national, sectoral, and local levels is required. This outreach should be informed by an assessment of specific examples of maladaptation in Bhutan to both alert and educate stakeholders.

Capacity building program and guidelines for project and program design and climate mainstreaming should include maladaptation as an important issue to be considered for planning and implementation of development activities.

There is a need for active coordination for climate actions and in dissemination and sharing of relevant information from the research and technical assessments.

Roles and responsibilities

National agencies should take the lead with Department of Environment and Climate Change playing a facilitative role. Regulatory agencies including MoIT needs to incorporate consideration of climate risks in its guidelines and regulations for human settlements and infrastructure. Maladaptation and climate risks should be considered as part of development consent processes.

Entities that generate relevant information such as NCHM, DGM and the research community should continue to generate relevant information with an emphasis on dissemination of results and findings to relevant audiences.

Sensitisation of maladaptation and climate risk should be included in disaster risk sensitisation exercises of DoLGDM and in communication and outreach programs for the NAP.

Key partners in avoiding maladaptation include *local governments* as they make decisions at local level on construction of infrastructure. In addition, *financial service providers* should consider climate risks in their lending decisions for development investments.

4.2 Approaches to implementing the adaptation priorities

The types of interventions under the adaptation priorities across the seven sectors (in chapter 3) ranged from direct interventions through technology transfer and infrastructure investments, to soft components such as market access, capacity building and management of information and data. To assist the implementation of the variety of adaptation priorities across the different sectors, consideration was given to possible approaches and opportunities for synergies and transformative actions.

4.2.1 Enabling activities to support the NAP process

To ensure the implementation of the adaptation priorities and support a continuous, progressive, and iterative NAP process, the enabling activities need to be implemented on a continuous basis.

The purpose of enabling activities to enhance national and local institutional capacity to plan and implement adaptation priorities by integrating them into development plans. Key elements in this regard include research to inform vulnerability assessments, design and preparation of adaptation priorities, implementation and monitoring and evaluation systems. The enabling activities in chapter 3 need to be implemented in conjunction with the implementation of the adaptation priorities.

4.2.2 Possible synergies and thematic approaches

However, there were two thematic approaches that emerged across the sectors and different actions and activities, in the form of ecosystem-based adaptation approaches (landscape, habitats, forests, ecosystems, watersheds) and human settlement services (rural and urban). The priorities for climate services and disaster risk reduction are considered as cross cutting issues. In considering a programmatic approach to implement the different priorities across the seven sectors, several different approaches could be taken. One of the simplest is to design a program along the lines of the seven different sectors. This may however miss out on ensuring synergies or transformative approaches in implementation. Several other approaches for an integrated approach to implement the adaptation priorities and needs is presented.

Synergies

There were quite a few possible synergies across the adaptation priorities and needs. There are *synergies across adaptation and mitigation* in forest management and energy security. Conservation and management of forests, watersheds, and habitats are critical for maintaining ecosystem services such as water and prevention of erosion and landslides and at the same time enhance mitigation through carbon sequestration.

In terms of energy security, development of alternate renewable energy generation and promotion of energy savings and efficiency is required to adapt to the high vulnerability of hydropower and at the same time these adaptation measures also result in mitigation through avoidance of GHG emissions in energy production.

The linkages and *nexus between food, water, energy, and climate* was also evident in the adaptation priorities across health, water and agriculture with many similar interventions being identified and prioritised across these sectors. Considering the COVID-19 pandemic, the concerns of zoonotic diseases were identified as a concern in forests and biodiversity sector and the agriculture and livestock sector because of changes in habitats from climate change and other threats to biodiversity.

Thematic approaches

There are several thematic approaches that could be followed to implement the adaptation priorities in an integrated manner. The following thematic approaches across the different sectors and emerged organically during the identification of adaptation priorities by the sectoral thematic working groups.

Integrated climate resilient human settlements

One of the common themes that emerged is human settlements and the need to make the rapidly growing cities resilient to safeguard the lives and livelihoods of an increasingly urbanised population. The entry points for integration into urban and rural development as discussed in the previous section also provide an excellent opportunity to ensure transformative changes and adaptation to ensuring a climate resilient and low emission cities and human settlements. The priorities in the human settlement sector have synergies with interventions safeguarding human health as many of the determinants of health are in other sectors such as the design and management of human settlements, particularly in ensuring water sanitation and hygiene (WASH). The Low Emission Development Strategies (LEDS) for Human Settlements prepared to support the implementation of the NDCs can also be implemented together with the NAP in a holistic manner, especially through the Regional Strategy and Framework for the National Capital Region (NCR) being spearheaded by the RCUD and MoIT.

Ecosystem-based adaptation

Ecosystem based adaptation (EbA) is another common theme that arose across multiple sectors, particularly in water, forests -and biodiversity, sustainable landscape approaches to agriculture and livestock management, and management of green spaces for urban and rural settlements. An ecosystem-based approach to adaptation would secure the resource base and other ecosystem services for human wellbeing in addition to mitigation co-benefits and biodiversity conservation. Ecosystem based approaches could be taken across different geographical areas such as a river basin, watershed, protected areas, an ecological zone, or in and around major human settlements.

Ecosystem based adaptation project is currently being implemented in by Thimphu Thromde and coordinated by the Department of Environment and Climate Change as part of a multi country project led by UNEP, "Building Climate Resilience of Urban Systems through Ecosystem-Based Adaptation (EbA) In the Asia-Pacific Region 'Urban EbA Asia'. This project will be a start to strengthening capacity, demonstrating EbA to reduce vulnerability of the poor and vulnerable and increasing the knowledge base forEbA. This small initial project in Bhutan will need to be scaled up based on the results and lessons learned.

Water

The focus of the NAP project has been on water as the most common theme that cuts across all sectors was water issues. Water is a critical resource for human consumption, food production and industries. Water is also a common factor for determining health and hygiene and in form of natural disasters like floods, landslides, and droughts. Interventions for adaptation for water ranges from ecosystem-based adaptation to technology transfer, infrastructure development and enhancement of management practices to secure the supply of water, efficient usage, and waste-water management.

Energy security

In the case of Bhutan, energy security is tied to the vulnerability of the water sector as electricity is almost exclusively through hydropower generation. Adaptation measures not only involve climate proofing hydropower facilities, but also requires diversification of energy sources into alternative renewable energy sources like solar, wind, and production of green hydrogen. There are also high levels of synergy with mitigation in energy generation by avoiding GHG emissions by promoting other renewable energy and with biodiversity conservation through the protection of watersheds and critical catchment area for hydropower.

4.2.3 *Prioritisation for implementation*

The identification of adaptation priorities in Chapter 3 considered past implementation of adaptation programs and projects to avoid repetition and duplication. When the adaptation priorities are integrated into national plans and priorities the process will require some amount of prioritisation and review as part of the normal planning process. It is also possible that some of the adaptation priorities may be taken up as major stand-alone projects under the new development planning approach to be taken up after the 12th Five Year Plan. In this regard, the following guidelines is recommended for selection of adaptation priorities and programs:

i. Sectoral programs and projects will be selected based on a review of past, ongoing and pipeline projects and will prioritise sectors and regions that have not received adaptation projects.
ii. The selection of geographic areas can be informed by the results of the vulnerability mapping of *dzongkhags* and *gewogs* from the "Climate Change Vulnerability Analyses and Mapping for NAP Process in Bhutan".

4.3 Potential Financing Sources

Bhutan's domestic financial resources are limited, and development assistance is still a major source of financing for the sustainable development programs and plans. The magnitude of financing required for climate change adaptation in the medium to long term may be more than the available resources. In addition, Bhutan's eventual graduation from LDC status will also remove the special consideration and access to financing provided to LDCs. Therefore, a variety of financing sources needs to be considered and explored from international climate financing mechanisms, bilateral, domestic, and private sources, and innovative mechanisms. Several channels and sources of financing for adaptation are discussed below.

It should be noted that access to these financing sources listed below requires that the adaptation priorities are integrated into national and sectoral plans prior to any approval for project development based on national procedures and norms (see section 4.1). Other donor requirements such as the Country Work Program (CWP) for the Green Climate Fund will also mean that the NAP will need to be included in an updated CWP.

4.3.1 *Financial mechanisms of the UNFCCC*

The various funds under the financial mechanism of the UNFCCC and the Paris Agreement such as the Green Climate Fund, Global Environment Facility, Special Climate Change Fund, Least Developed Countries Fund and the Adaptation Fund were established to support the implementation of climate change actions in developing countries and will continue to be an important source for the implementation of the NAP.

To facilitate access to these funding sources, national focal institutions accredited to these funds will need to enhance their capacity to channel financing to national and local stakeholders. Currently

Bhutan Trust Fund for Environmental Conservation (BTFEC) is accredited as a national Direct Access Entity (DAE) to the GCF, and as National Implementing Entity (NIE) to the Adaptation Fund. The Bank of Bhutan and Bhutan National Bank are also under process of accreditation to the GCF and will be important channels for the participation of the Bhutanese private sector in climate change adaptation and mitigation.

4.3.2 MULTILATERAL AND BILATERAL CHANNELS

Multilateral development banks

Multilateral development banks such as the Asian Development Bank, and the World Bank support economic development programs including climate change initiatives in Bhutan through loans and grants. Bhutan is also now eligible to access financing from the European Investment Bank. Accessing borrowings from multilateral development banks are channelled through the Ministry of Finance.

Bilateral development partners

Bhutan has bilateral ties with over fifty countries, and many are development partners. Many of these countries also have bilateral development cooperation agencies, which have climate change programs.

4.3.3 INNOVATIVE NATIONAL MECHANISMS

National Domestic revenues are limited and with many competing demands for delivering basic sustainable development services, innovative and alternative sources of financing at national level are required to supplement international financing for climate adaptation.

- The **Bhutan Trust Fund for Environmental Conservation** (BTFEC) was one of the pioneering innovative conservation financing funds set up in 1996. The BTFEC finances conservation and climate change projects in Bhutan from a 40-million-dollar endowment. It makes large grants up to Nu.15 million for three years and small grants of up to Nu. 400,000.

- The Royal Monetary Authority of Bhutan (RMA) is pursuing green financing options as part of its 10-year strategic plan, "*Druk Ngudrel Lamtoen-2030: A Roadmap for a Progressive, Agile, and Resilient Central Bank Enabling Bhutan's Economic Transformation*". Under the 3rd pillar of this strategic plan, "**Advancing Green Finance for Sustainable and Green Economy,** RMA aims to (i) Create enabling regulatory environment to nurture financing in green economy and (ii) Develop capital market and innovative financial instruments to promote investment in green projects and businesses. Towards this the RMA will (i) establish a governance and coordination mechanism to promote green finance (ii) incorporate environmental and social risk management in financial service provider's lending decisions (ii) create green taxonomy and (iv) promote green capital market.

- The **Bhutan Climate Fund (BCF)** is being developed with the assistance of the World Bank to facilitate the monetisation of net negative emissions and carbon offsets from mitigation projects under the new carbon market mechanisms of Article 6 of the Paris Agreement. The BCF is intended to increase the viability of hydropower projects in Bhutan and support the implementation of Bhutan in meeting its NDC commitments, adaptation needs, and overall development objectives.

- Sustainable Development Fee (SDF). Effective from 23 September 2022 a revised tourism policy of Bhutan took effect with the opening of the country after the COVD-19 Pandemic. Along with several significant changes, and the SDF applicable to all inbound tourists (with few exceptions) was increased to US$200 per day (previously at $65). The increased SDF is intended to support national development priorities including sustainability and carbon footprint of the industry. Funds from the SDF could also support climate resilience activities in addition to carbon neutral activities.

- The Private Sector. As discussed in Box 5, the private sector must not only adapt to climate change in making investments but can also be a partner in financing and implementing adaptation.

4.4 Communication and Outreach

To facilitate the implementation of the NAP, all stakeholders from decision makers on policies to budget allocation, planners, implementers and beneficiaries need to be sensitised about the NAP, adaptation priorities, and their role in the NAP process. In this regard, the advocacy and outreach program will contain the following elements.

4.4.1 Target Audience:

The outreach and communication for the NAP is targeted to both domestic stakeholders to implement relevant priorities and to the international community to facilitate provision of support for adaptation implementation in Bhutan.

4.4.2 Roles and responsibilities of national stakeholders:

The roles and responsibilities of the different stakeholders are described in section 4.5 on Roles and Responsibilities, and in Chapter 3 on adaptation priorities and needs and Chapter 5 on Monitoring and Evaluation.

4.4.3 Modalities for outreach on NAP implementation:

Due to the different types of stakeholder groups with differing levels of messaging required, the modalities for outreach and communication will be different. Therefore, the following approach is recommended for outreach and communication:

- National planners, decision makers will be sensitised through policy briefings and seminars.

- Local level planners and decision makers will require, policy briefings, seminars, trainings, and workshops. Participants in the different outreach modalities will need to be determined and may also require targeted trainings and outreach activities.

- Civil society and private sector groups can also be covered through policy briefings, seminars, trainings, workshops. In addition, it is also recommended to conduct regular interchanges such as through a platform for a dialogue on policy, science, and practice.

- **Research and Academia** are important stakeholders in providing support to the NAP process with policy relevant research and can also part of a regular platform for dialogue for policy, science, and practice and subsequent integration of topics into the education curriculum.
- **Donors and development partners** can be sensitised through briefings, outreach campaigns and dialogues such as the periodic Round Table Meetings or other platforms.
- The **general public and communities** can be sensitised through media channels and targeted communication campaigns at grassroot levels.

4.5 Roles and responsibilities

The implementation of the NAP will be in facilitated in line with the mandates under the Climate Change Policy. In this regard, the following roles and responsibilities are defined:

	Function	Agency
1	Leading the NAP process including preparation of the NAP	NEC Secretariat (DECC)
2	Integration of NAP into development plans	NEC Secretariat (DECC), MoF, OCASC
3	Resource mobilisation and allocation	MoF
4	Overall monitoring and coordination of climate change action	NCCC/DECC
5	Implementation of priorities in line with mandates	All agencies, stakeholders including CSOs

5. MONITORING AND EVALUATION

The monitoring and evaluation (M&E) of the NAP and NAP process is considered at three different levels. The 1st level is M&E of this NAP to ensure the implementation of the adaptation priorities and enabling activities in line with the implementation strategy. The 2nd level is monitoring and reporting on adaptation action at the national level in line with the national climate change policy. The 3rd level is reporting is at the international level under the Paris Agreement and obligations for submission of Biennial Transparency Reports, which also requires information on adaptation.

5.1 MONITORING AND EVALUATION OF THE NAP

The first level of M&E is on the NAP document, and this will assess progress in implementing the adaptation priorities as well as progress in the NAP process.

5.1.1 M&E OF THE IMPLEMENTATION OF ADAPTATION PRIORITIES

M&E of progress in implementation of the adaptation priorities will be based on the adaptation priorities in chapter 3 on Adaptation Priorities. The objectives, outcomes, actions, and key performance indicators across the seven sectors will be the basis for assessing progress and effectiveness in implementation of the NAP. The major thematic approaches for implementation in chapter 4 can also inform the M&E of implementation of adaptation priorities.

Along with the M&E, of programs and projects, the following should also be completed to support an iterative NAP process.

i) The best practices and lessons learned (BPLL) should be captured to inform the next iteration of the NAP. The BPLL should examine the integration of adaptation into development planning, avoidance of maladaptation, and the opportunities for synergies (across sectors, between adaptation and mitigation, with sustainable development, and with other multilateral agreements).
ii) Adequacy of support received for implementation in the form of finance, technology, and capacity building.
iii) Assessment of gaps and barriers in NAP implementation, inclusivity of vulnerable groups, the private sector, civil society, and gender considerations

The overall responsibility for initiating the M&E of the NAP will be with the NEC Secretariat (DECC) and reported though the C4 to the NEC/NCCC. Information for overall progress will be provided as follows:

i) Information on the outputs of specific programs and activities will be provided by the lead agencies and collaborators based on the tables in Chapter 3.
ii) Overall Progress and achievement of NAP Priorities (document) will be evaluated by the C4 through the CCD/NECS and reported to the NCCC.

The following modalities will be used for the M&E of the implementation of the adaptation priorities.

i) Stocktake against priorities in the NAP Document

ii) Consultation meetings or surveys guided by a framework for stock take to be developed prior to the meeting/survey and based on priorities in chapters 3, 4 and 5. Collection of gender disaggregated data shall be followed as applicable.
iii) Annual reports to C4/NCCC and cabinet as per CC policy
iv) Reports to funding agencies (project level reporting) as required and appropriate.

The timing of the M&E shall be as follows:

i) Annual survey of progress or a stocktake meeting to report on activities.
ii) A mid-term review in year 2.5 and completed by year 3 at the latest will inform next phase of NAP
iii) By year 4, preparations for the formulation for next iteration of the NAP should begin based on evaluation of reports from (i) & (ii)
iv) By end of year 5 the subsequent NAP must be ready (with short term priority to 5 years and rolling priorities till year 10.)
v) At end of year 5, evaluation of NAP
vi) Align the stock-takes and reviews together with preparation of BTR to reduce duplication of efforts.
vii) Post project/post NAP period review/evaluation after 2-3 years of previous NAP for sustainability and impact

5.1.2 M&E OF THE NAP PROCESS

The M&E of this NAP will also assess the NAP process to ensure the continuity in the support and process for adaptation planning and implementation. The M&E of the NAP process shall be based on the "enabling activities" in chapter 3 and program developed for enabling activities in line the implementation strategy in chapter 4. The roles and responsibilities, modalities, and timing for M&E of the enabling activities will be the same as the M&E for adaptation priorities above.

Some additional elements to be covered in the M&E of the NAP process are:

i) Outcomes and Key indicators in Table on enabling activities in chapter 3.
ii) Other outputs of the NAP readiness project such as the climate research roadmap, stakeholder engagement plan, policy review.
iii) The overall effectiveness of the NAP process can be assessed using the LDC Expert Group's PEG M&E tool to gauge the 'progress, effectiveness, and gaps' (PEG) based on the 10 NAP essential functions.

5.2 M&E TO SUPPORT NATIONAL REPORTING UNDER THE CLIMATE CHANGE POLICY

The second level of M&E is national level reporting on progress towards developing climate resilience in Bhutan. M&E for this is defined by the requirements of the Climate Change Policy (CCP) 2020 and may cover additional processes and actions beyond activities within this NAP. The purpose of M&E under CCP 2020 is to ensure coherence in national efforts for climate action.

5.2.1 PROCESS FOR MONITORING, REPORTING AND EVALUATION UNDER THE CLIMATE CHANGE POLICY

The requirements of M&E under CCP 2020 are defined in section 6 of the policy. This section of the policy defines a general process and hierarchy of reporting on actions towards comprehensive climate action including mitigation, adaptation, means of implementation. The section defines roles for the NCCC, C4, NECS and all relevant agencies and organization. The NECS and C4 as the secretariat and technical coordinating body have a key role in ensuring monitoring and reporting on progress are carried out as part of their mandates. The role of the Cabinet, Royal Audit Authority and Parliament are also defined in ensuring oversight in evaluating progress under the policy.

5.2.2 MEASURING RESILIENCE AND ADAPTIVE CAPACITY

Besides process requirements for monitoring and reporting procedures in section 6 of the CC Policy, Policy Objective 2: "Building resilience to climate change", requires assessing climate resilience. Statement 2.4 of this objective states, "*Assess progress in adaptation including measurement of resilience to climate change*." Measuring resilience under this statement is in line with one of the overarching NAP objectives to "*Reduce vulnerability to the impacts of climate change by building adaptive capacity and resilience"*.

Measuring resilience and adaptive capacity is a complex endeavour and as of date Bhutan has not adopted a system to assess climate resilience and adaptive capacity. Such a system will require continuous research and reporting and numerous inputs and variables to inform the status and progress in assessing climate resilience. Following an examination of various options for assessing progress on adaptation[14] and the experience in preparing the NAP in Bhutan, it is recommended that a system for measuring climate resilience be developed based on the approach already undertaken in the "Climate Change Vulnerability Analyses (CCVA) and Mapping for National Adaptation Plan (NAP) formulation process in Bhutan[15]" (NEC 2021).

The approach under the CCVA mapping exercise are as follows:

i) The basic approach to assess resilience follows the Climate Change Risk Assessment Framework as per the fifth assessment report (AR5) of Intergovernmental Panel on Climate Change (IPCC)

[14] Adaptation Committee, Technical Paper on Approaches to reviewing the overall progress made in achieving the global goal on adaptation, 9 April 2021, UNFCCC

[15] http://www.nec.gov.bt/publications/download/climate-change-vulnerability-analyses-and-mapping-for-nap-formulation-process-in-bhutan

ii) A spatial component to measure differences in adaptive capacity and risks across regions and communities and populations is assessed through spatial analysis using GIS.

iii) A temporal component is included to track the dynamic nature of climate change. This component will require future projections and replication of the assessment in a periodic and continuous manner.

The CCVA Mapping was undertaken as part of the NAP preparation process to assess vulnerability and risk assessments across various administrative regions in Bhutan to inform decision making for adaptation planning and budget allocation. The indices could be used as a proxy for resilience across different regions and over time used to assess trends in adaptive capacity and resilience. The data and variables informing this assessment is illustrated in figure 40 below. This approach is like a scoreboard approach to assessing progress across different criteria and among different regions and countries.

The baseline for Bhutan has already been developed in 2021 in the first CCVA exercise and should be further refined and updated to track progress and trends in climate risk and adaptive capacity over time. The next assessment should be undertaken in time to inform the preparation of Bhutan's 2nd NAP.

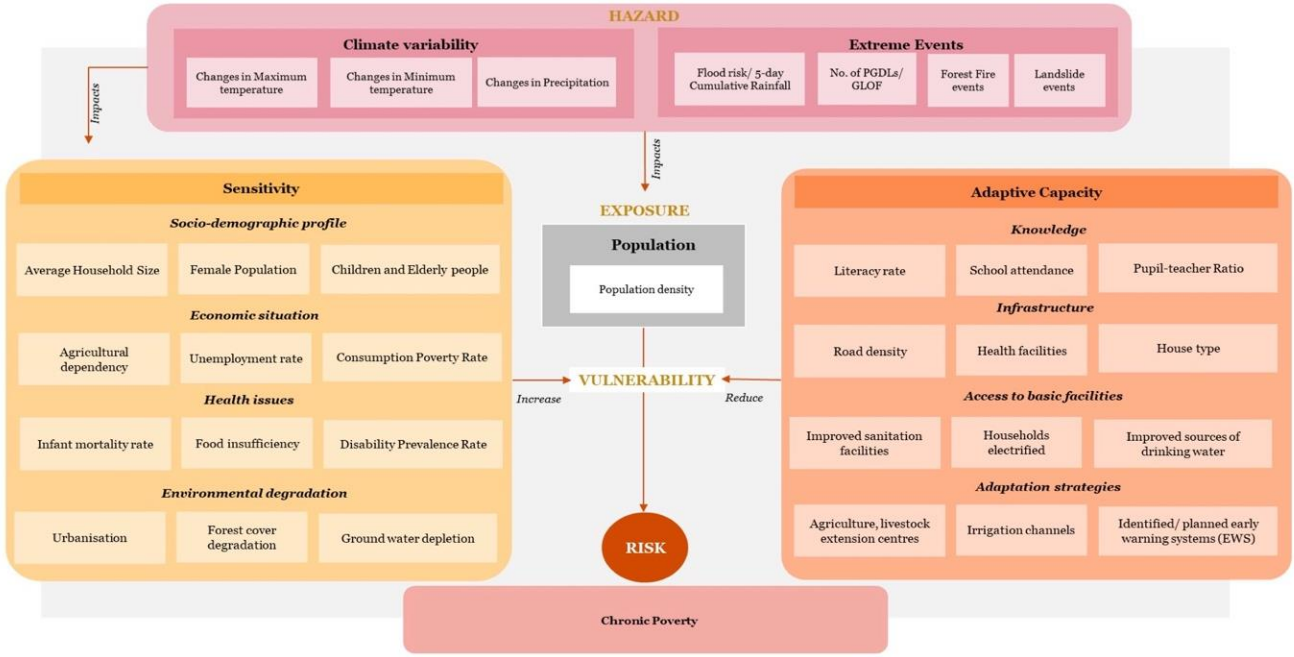


Figure 40: Impact chain describing the relationship between the factors that drive vulnerability in Bhutan (NEC 2021)

5.2.3 TRACKING SUPPORT

Ensuring adequate means of implementation is key to achieving the objectives of climate action and is recognized as such in the CC Policy and also in the UNFCC and Paris Agreement. Under the CC Policy 2020, Policy Objective 3: "ensure means of implementation", states that support should be provided through finance, technology, capacity building, research and awareness to support both mitigation and adaptation. The CC policy states that resources should be provided from a mix of domestic and international sources through the government budgetary system. Policy statement 3.1.4 states that the RGOB should, "*Monitor and report flow of financial support from domestic and international sources*

for climate action through the government budgetary system to ensure transparency of support needed and received." This policy statement on monitoring and reporting the flow of financial support is intended to ensure transparency of support for climate action and is aligned to support national reporting to the Paris Agreement as part of the Enhanced Transparency Framework (ETF).

5.3 M&E TO SUPPORT INTERNATIONAL REPORTING UNDER THE PARIS AGREEMENT

All parties under the Paris Agreement are obligated to submit Biennial Transparency Reports (BTR) every two years. The BTR should include national GHG inventories, achievements towards NDCs, and should also report on climate change impacts and adaptation. Developing countries should also report on support (finance, technology, capacity building) needed and received.

Elements for the M&E system as described in the previous sections such as adaptation priorities and enabling activities in the NAP document, the M&E process under the CC policy and measuring resilience not only to respond to national requirements for M&E but will also contribute to international obligations for reporting under the Paris Agreement. Information on what is to be reported for adaptation under the ETF and BTRs can be found in the Reference Manual for the Enhanced Transparency Framework under the Paris Agreement (UNFCCC 2020).

5.4 DEVELOPING A NATIONAL M&E SYSTEM FOR CLIMATE CHANGE

In developing a national M&E system for adaptation, this will be undertaken as part of the M&E requirements under the CC Policy 2020 should be complementary and build on existing national monitoring and evaluation systems. Some of the relevant tools and guidelines include, Development Evaluation Policy of Bhutan 2017 and its Protocol and Guidelines, electronic Public Expenditure Management System (ePEMS) and the Annual Performance Agreement (APA) for line agencies of the government.

Since periodic reporting will be required as part of the Biennial Transparency Reports (BTR) to be submitted under the Paris Agreement and requires additional resources, support to develop a national system for transparency and reporting is available as part of the Capacity Building Initiative for Transparency (CBIT) through the GEF.

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ANNEXURES

ANNEX 1: SUMMARY OF THE ESTIMATED COST

DETAILED ADAPTATION PRIORITIES		
Sl. No.	Activity	Estimates in USD
A	WATER	
1	Improve natural capacity for infiltration, water recharge, and water buffer for prevention of fast runoff and erosion	500,000
2	Strengthen and upscale PES. Review PES framework and field guide	100,000
3	Conduct feasibility studies to build emergency storage, bypasses, and controlled releases from glacial lakes. River basin management and planning for basin optimization.	62,000
4	Promotion of water efficient technologies Conduct advocacy on water efficient technologies	23,500
5	Ensuring proper monitoring, planning and supply of drinking water	123,000,000
6	Exploring volume of rainwater generated at water stressed areas for domestic use. Developing assessment guide for integration of holistic use of water resources	200,000
7	Reduction of Non-Revenue Water losses	6,500,000
8	Strengthen database/inventory on drinking water supply schemes	4,000,000
9	Improve planning, designing and implementation of climate resilient irrigation	70,000,000
10	Robust water resources planning and monitoring system	18,000
11	Strengthening research on water resource management including	25,400
12	Strengthening research on water resource management including groundwater resources. i. Research on water resource management including groundwater resources and soil moisture ii. Enhance hydrological and groundwater modelling. iii. Carry out studies on the options for household/institution level rainwater harvesting or creating additional water storage capacity. iv. Assess climate risk on water intensive industries (168 water intensive industries as of 2022)	183,000
13	Enhancing capacity of key stakeholders in managing the impacts of climate change on water	135,000
14	Capacity development of flood and storm water management from river flooding and urban floods	150,000
	SUB TOTAL WATER	204,896,900
B	AGRICULTURE AND LIVESTOCK	
1	Efficient utilization of alpine rangeland and development of agroforestry systems for livestock	40,000
2	Sustainable management and utilization of alpine rangeland resources	2,000,000
3	Mapping and identification and assessment, of indigenous forage/grass species	140,000
4	Enhanced availability of feeding resources through agro-forestry system	3,000,000

5	Promote pasture under agro-forestry system (orchard, silvo pastoral)	133,000
6	Upscale usage of crop residues through enrichment and fodder conservation	130,000
7	Conservation and promotion of climate resilient native livestock breeds Conservation and development of native poultry breeds	200,000
8	Conservation and development of native piggery breeds	200,000
9	Development of suitable Bhutanese cattle breed through cross breeding	100,000
10	Promotion of advanced livestock reproductive technologies (Sex sorted AI, ET,) for enhanced dairy productivity	100,000
11	Promote Effective Microorganism Technology (EMT) in poultry and piggery farms	350,000
12	Fencing on pastureland to reduce incidence of wildlife depredation on livestock	1,000,000
13	Improve micro-climate conditions in animal sheds	700,000
14	Expand apiculture for boosting honey production and enhance crop productivity	2,000,000
15	Water efficient and low-cost fodder production during lean season (hydroponics)	300,000
16	Promote heat and cold resistant fodder varieties	30,000
17	Adopt labor saving devices and equipment to reduce drudgery on women and vulnerable groups	200,000
18	Expand community-based capture fisheries.	50,000
19	Explore cage culture fisheries in inland water bodies and hydropower dams	100,000
20	Explore and introduce low-cost fish production technologies (aquaponics)	133,000
21	GIS application for livestock development (to map migratory cattle and yak herds)	100,000
22	Digitalization to generate real time data for informed decision making	50,000
23	Reduced vulnerability of livestock farmers against losses from climate change impacts	3,000,000
24	Institute recording and reporting system on livestock lost due to climate induced extremes	33,000
25	Improve farm biosecurity	33,000
26	Strengthen transboundary animal disease reporting and management system	10,000
27	Initiate herd health management	50,000
28	Promote and popularize traditional knowledge and practices for safe and sustainable livestock production	33,000
29	Promote adoption of micro irrigation (Drip, sprinkler) by increasing accessibility to farmers through simple, affordable, and smart technology	5,000,000
30	Improve soil carbon, health and fertility through adoption of improved and integrated soil nutrient management practices	60,000,000
31	Strengthen pest surveillance system and diagnostic facilities Develop and Promote Integrated Pest Management technologies	2,000,000
32	Develop efficient post-harvest infrastructures and distribution system.	4,000,000

33	Institute climate risk management for food production through insurance and compensation schemes covering climate change impacts	4,000,000
34	Adopt innovative, gender responsive technologies for smart climate resilient farming	1,500,000
35	Explore, develop and promote climate resilient crop varieties and climate smart technologies to improve sustainable production systems	2,000,000
36	Targeted and enhanced capacity building for adaptation for food security	500,000
37	Targeted training on impacts of climate change in food production at sectoral to community levels.	2,000,000
	SUB TOTAL FOR AGRICULTURE AND LIVESTOCK	95,215,000
C.	FOREST AND BIODIVERSITY	
1	Develop and implement the forest fire management strategy and plans	1,000,000
2	Continue implementation of the plan	500,000
3	Conduct Capacity Need Assessment and build capacity.	400,000
4	Conduct periodic training on forest fire management for multi stakeholders	500,000
5	Upscale and strengthen the Dzongkhag level fire management interventions. Integrate Dzongkhag and local level fire management plans	800,000
6	Implement advance early warning systems	500,000
7	Strengthen forest fire surveillance and communication system (including forest fire suppression equipment)	1,500,000
8	Strengthen support for large fires and IFCG	3,000,000
9	Develop awareness program/ materials and carry out awareness	50,000
10	Carry out awareness campaigns	20,000
11	Manage fuel load	250,000
12	Manage fuel load	300,000
13	Carry out post fire habitat management	500,000
14	Carry out post fire habitat management	500,000
15	Develop capacity to monitor biodiversity and support implementation of Bhutan Biodiversity Monitoring Protocol	100,000
16	Continue support to implementation of biodiversity monitoring protocol	200,000
17	Strengthen existing database systems.	50,000
18	Updating the revamped database system	50,000
19	Build capacity to conduct NFI and biodiversity survey	10,500,000
20	Develop database systems and implement the database to document and monitor	500,000
21	Develop NFI database	300,000
22	Develop capacity to conduct NFI and data analysis	200,000
23	Procure equipment and conduct NFI	4,000,000
24	Develop and implement online National Forest Monitoring Portal to monitor forest cover change on real time basis	300,000
25	Integrate National Forest Monitoring Portal into the existing NFMS	200,000
26	Assess and enhance technical capacity and infrastructure	500,000

27	Implement molecular techniques and methodologies for biodiversity assessment	10,000
28	Develop suitable guidelines for plantations and regeneration in broadleaved forest	20,000
29	Assess existing plantations and formulate suitable plantation techniques and regeneration methods	20,000
30	Carry out plantation in identified broadleaved forest (FMUs, LFMAs) and maintain these sites through community engagement	200,000
31	Carry out plantation in identified broadleaved forest (FMUs, LFMAs) and maintain these sites through community engagement	300,000
32	Carry out reforestation in degraded areas in SRF	200,000
33	Maintenance of reforestation in degraded areas in SRF	300,000
34	Identification and mapping of sites requiring restoration and rehabilitation	100,000
35	Carry out habitat management interventions such as enrichment plantations, grassland and alpine meadow management, salt licks, snags, waterholes, river back protections, etc. in identified areas	300,000
36	Carry out habitat management interventions such as enrichment plantations, grassland and alpine meadow management, salt licks, snags, waterholes, river back protections, etc. in identified areas	1,000,000
37	Identification and mapping of fragile habitats and species	30,000
38	Develop and implement sustainable restoration plans.	50,000
39	Implement sustainable restoration plans	150,000
40	Develop legal framework for inclusion of wildlife movement friendly infrastructure to enable long term migration under climate change	50,000
41	Support to implementing the existing Zero Poaching Strategy	1,000,000
42	Revise and implement Zero Poaching Strategy	1,200,000
43	Identify and map areas prone to pests and diseases, and initiate periodic	50,000
44	Continue periodic monitoring and surveillance of the identified areas.	100,000
45	Project pest and disease spread through scientific modelling	50,000
46	Develop required mitigations/interventions based on the results from the monitoring.	100,000
47	Develop pest and disease strategy and management plan, and support implementation	50,000
48	Continue implement pest and disease strategy and management plan.	100,000
49	Identify zoonotic diseases and implement strategic actions.	150,000
50	Support implementation of wildlife health strategy	100,000
51	Support to review the wildlife health strategy and continue to support implementation.	100,000
52	Develop capacity on GIS & RS, entomology, and Drone mapping	500,000
53	Build capacity on assessment, control, and management of invasive species	1,000,000
54	Training on techniques for control of alien invasive species	1,000,000
55	Implement IAS management plan	100,000
56	Strengthen surveillance and monitoring of IAS.	150,000
57	Prevent introduction and establishment of IAS and manage existing IAS	50,000

58	Prevent introduction and establishment of IAS and manage existing IAS.	100,000
59	Support socio-ecological assessment of Transboundary Peace Park and support development and implementation of its management plan	50,000
60	continue support to implementation of the management plan of the Peace Park	100,000
61	Identification of Other Effective Area Based Conservation Measures (OECMs) and development of plans for identified areas.	300,000
62	Implementation of the management action plans	500,000
63	Support to implementation of the Human Wildlife Conflict Management (HWCM) Strategy	1,000,000
64	Revise and implement the HWCM Strategy.	1,500,000
65	Support to implementation of the PA management plan	500,000
66	Support to revision of climate smart management plans of PAs and implementation.	1,000,000
67	Promote Community Based Natural Resource Management (Community Forests, NWFP, Agroforestry)	500,000
68	Continue support to revision and implementation of CF, NWFP and Agroforestry plans	1,000,000
69	Support to implementation of FMU management Plan	200,000
70	Support revision of management plans of FMUs and implementation.	500,000
71	Support community-based cottage scale forest enterprises (NWFP, Wood, Ecotourism)	1,000,000
72	Continue to promote community-based cottage scale forest enterprises (NWFP, Wood, Ecotourism)	500,000
73	Develop and implement strategy for development of wood-based industries to reduce timber wastage following circular economy concept	100,000
74	Develop and implement strategy for sustainable timber harvesting and utilization	200,000
75	Promote adoption of efficient and climate smart timber processing technologies to improve wood-based industries (WBI) to reduce wastage and maximize timber utilization.	500,000
76	Promote adoption of efficient and climate smart timber processing technologies to improve wood-based industries to reduce wastage and maximize timber utilization.	500,000
77	Carry out capacity development program in timber processing, wood science and technology.	200,000
78	Carry out capacity development program in timber processing, wood science and technology.	300,000
79	Need assessment in natural product development and market analysis	20,000
80	Develop nature-based products to derive benefits and equitable sharing among rural communities	100,000
81	Infrastructure development (Lab and equipment's)	1,000,000
82	Promote Access and Benefit Sharing (ABS) regime	30,000
83	Enhancing the use of local knowledge and beliefs for the conservation of biodiversity and forest	1,000,000
84	Research on phytochemical analysis and product development	500,000
85	Develop gender responsive natural resources access framework	20,000
	SUB TOTAL OF BIODIVERSITY AND FOREST	48,470,000

D.	HUMAN SETTLEMENTS AND CLIMATE SMART CITIES	
1	Develop-climate smart cities and human settlements.	676,329
2	Leverage "green infrastructure" for ecosystem-based adaptation in urban areas.	1,000,000
3	Implement green infrastructure plan as part of implementation of Thimphu structure plan.	20,000,000
4	Ensure/Green space; micro parks, avenue plantation, green building components in urban/town areas.	6,039
5	Build comprehensive database for urban areas	579,710
6	Enhance logistics preparedness for disaster management and improved service delivery	241,546
7	Climate proof critical infrastructures and settlements against floods and landslides i. Provide climate resilient infrastructure in critical areas for disaster risk reduction ii. Review and develop flood and storm water management plans and Low Impact Development Plans for urban areas iii. Review design of Flood protection management protective structures like dams, drainage systems, and barriers in flood-prone areas including in industrial/economic zones.	78,381,643
8	Strengthen windstorm management through capacity building and awareness	114,734
9	Construct climate resilient road infrastructure i. Reduce risk of landslides from increased precipitation in critical zones ii. Construction of climate resilient road infrastructure	12,987,922,705
	SUB TOTAL HUMAN SETTLEMENTS AND CLIMATE SMART CITIES	**13,088,922,705**
E.	HEALTH	
1	Strengthen laboratory facilities and monitoring systems for climate sensitive diseases.	1,811,594
2	Improve access to water supply and sanitation for health facilities	603,865
3	Conduct vulnerability assessment of health care facilities for climate change induced disasters	3,683,575
4	Strengthen the monitoring mechanism for WASH improvements in HCFs through close collaboration among RCDC, IPC, QASD and AMR	60,386
5	Strengthen waste management system in healthcare facilities and Thromdes to control climate sensitive disease vectors	458,937
6	Capacity development on climate induced emergency medical services	4,227,053
7	Strengthen existing surveillance system	30,193
8	Develop a vector borne diseases early warning and prediction model	42,271
9	Develop monitoring framework for prevention and control of climate sensitive diseases	42,271
10	Cross border collaboration for climate sensitive diseases prevention and control (migrant screening, vector surveillance in project areas, awareness)	30,193
11	Review and sustain cross border collaboration	30,193
12	Enhance capacity of health workers for management and surveillance of climate sensitive and vector borne diseases	90,580

13	Establish national center for training and research on VBDs and zoonoses	5,434,783
14	Develop HR capacity for National centre on training and research for climate sensitive diseases	90,580
15	Operational research on VBDs	30,193
16	Develop community capacity for prevention of VBDs in high-risk areas	45,290
17	Review of community participation to develop sustainable community engagement plan	45,290
18	Capacity development of pre-service and in-service health workers on water quality monitoring as per international standard	120,773
19	Enhance capacity for diagnosis and management of new/emerging climate sensitive diseases)	36,232
20	Training of health workers on climate change adaptation using WHO training modules	301,932
21	Create awareness to workers and employers of the potential accident and disease risks associated with climate variabilities	48,309
22	Integrate and organized climate change teaching and learning curriculums	362,319
23	Strengthen disease outbreak investigation and response for prioritized zoonoses issues.	603,865
24	Conduct awareness campaigns on risks of increased zoonoses events from human wildlife interface and livestock due to climate change.	603,865
25	Conduct climate change related emerging disease burden study in the country	241,546
26	Assess health system vulnerability and adaptation to climate change	483,092
27	Policy review on integration of health in policies of health determining sectors	30,193
28	Assess risk of heat waves and heat stress across different population groups	72,464
	SUB TOTAL OF HEALTH	**19,661,835**
F.	ENERGY	
1	Implementation from the recommendation of green hydrogen roadmap	6,000,000
2	Implement rooftop solar PV at consumer's premises and development of prosumer market.	60,000,000
3	Renewable Energy for Climate Resilience (Phase-II)	382,000,000
4	Promoting Energy Security and Transition Project	8,000,000
5	Implement waste to energy plant	1,000,000
6	Install Solar Water Heating System	1,000,000
7	Development of Energy Information System	500,000
8	Development of Minimum Energy Performance Standards (MEPs)	500,000
9	Development of energy efficiency codes of practice for Building	1,000,000
10	Implementation of energy efficiency codes of practice for industries	200,000
11	Certification of energy professional as energy auditors	100,000
12	Certification of Energy Efficiency buildings	200,000
13	Strengthening of Electrical testing laboratory	1,000,000
14	Study on investment opportunities for energy efficiency projects	200,000

15	Assess and incorporate climate resilient energy technologies and power system infrastructure	12,000,000
16	Undertake Feasibility Study of a Pumped Storage scheme and DPR update of reservoir type hydropower project	8,000,000
17	Development of a Pumped Storage Power Plant (PSPP) and reservoir type hydropower projects	1,985,677
18	1 PSPP and 1 Reservoir Hydropower Projects developed	1,994,364
19	Construction of Nyera Amari-I&II Integrated HPP;	376,925
20	Construction of Begana Integrated Multipurpose Small Hydropower Projects (IMSHP)	29,752
	SUB TOTAL OF ENERGY	486,086,718
G.	CLIMATE SERVICE AND DISASTER RISK REDUCTION	
1	Operationalize the generation of agro-met advisory services. Establish end-to-end channels of dissemination of weather and climate advisories (media, SMS, community network etc.)	1,000,000
2	Develop a grassroots advocacy program on early warning preparedness for farmers and communities on extreme events and seasonal risks	300,000
	SUB TOTAL OF CLIMATE SERVICE AND DISASTER RISK REDUCTION	1,300,000
DETAILED ENABLING ACTIVITIES		
A.	POLICY AND INSTITUTIONAL	
1	Develop TOR and mandates and identify climate change units in line with CC policy and NEPA 2007 Institute CC units in national agencies	25,000
2	Develop TOR and mandates for climate change units in line with CC policy and NEPA 2007 and LG Act, and of Gender, Environment, Climate, Disaster, Poverty (GECDP)	50,000
3	Review and revise policies and legislation for gaps and opportunities in effective integration and implementation of climate action.	100,000
4	Strengthen the NEC Secretariat (CCD/DECC) in supporting the NCCC (HR, training, resources) Regular briefings to NCCC on CC Adaptation and NAP process as necessary. Annual review on NAP process by NCCC (based on C4 reports)	10,000
5	Capacity building of Climate change Coordination Committee (C4) for its mandate on adaptation (Capacity building of members of C4) Review progress in NAP process covered in meetings of the NCCC	50,000
6	Enhance One Health Initiative of MOH to include other sectors for climate change priorities in NAP	10,000
7	Continuous enhancement and maintenance of Bhutan Climate Platform to support NAP process Trainings for new collaborators and refresher for focal persons	300,000
8	Regular engagement with CSOs and the private sector on NAP process and adaptation implementation	100,000
	SUB TOTAL OF POLICY AND INSTITUTIONAL	645,000
B.	MONITORING AND EVALUATION AND NAP PROCESS	
1	I. Prepare annual progress report on implementation of the NAP II. Capture best practices and lessons learned (BOPLL) in implementation	300,000

	of the NAP III. Prepare 2nd NAP in an iterative manner	
2	I. Review and enhance the approach in "Climate Change vulnerability analyses and mapping for NAP formulation process in Bhutan" for measuring vulnerability & adaptive capacity at a national level and across sub-national levels of dzongkhags and gewogs II. Develop a tool for assessing adaptive capacity and vulnerability to climate change to assist planners and practitioners for planning and implementation of adaptation projects and programs.	300,000
3	Establish a national monitoring and tracking system to report on "support received" for climate change actions (mitigation and adaptation) for the Biennial Transparency Reports (BTR) by assessing and building on existing national monitoring systems. Assess and prepare a report on the Progress, Effectiveness and Gaps (PEG) on NAP process by year 3 of NAP implementation program.	100,000
4	Set up an M&E framework for the water sector along the lines of the Bhutan Water Security Index (BWSI).	100,000
	SUB TOTAL OF MONITORING AND EVALUATION AND NAP PROCESS	800,000
C.	RESEARCH AND DATA	
1	Conduct policy-relevant and need-based research for climate change adaptation through "Strategic Imperative I: Tackle issues which matter"	5,000,000
2	Disseminate and increase awareness of climate change research to inform adaptation planning in Bhutan and further through strategic imperatives III and IV of the Roadmap	300,000
3	Strengthen and build sustainability of climate change research to support the NAP process for through strategic imperatives II & V and update of the roadmap.	5,000,000
	SUB TOTAL OF RESEARCH AND DATA	10,300,000
D.	CAPACITY BUILDING	
1	I. Development of climate change learning module and curriculum II. Vocational Education Curriculum Development for Climate Mitigation and Adaptation III. Creating awareness for students and their parents to understand climate change adaptation as a career option	300,000
2	Training of Trainer (TOT) programs and development of training modules at RUB and RIM	100,000
3	I. Strengthen linkages with government, academia and extension capacity of NGOs and CSOs operating in natural resource management/agriculture space; II. Develop and implement a public sensitization program on IKS across the community level; III. Develop a repository of all traditional and Indigenous knowledge systems Mainstream IKS in development projects.	600,000
4	Develop financing strategy for capacity building Mainstream climate change capacity development in sectoral and local budgets	300,000
	SUB TOTAL OF CAPACITY BUILDING	1,300,000

E.	EDUCATION AND AWARENESS	
1	Review and integrate climate change and adaptation into education curriculum in a comprehensive and holistic manner at appropriate levels d. Update information on CC for already integrated curriculum (higher levels) e. Refreshers and training for teachers f. Fill gaps in lower level by activity or other modes (clubs, activities, scouts, exploratory)	300,000
2	Provide scholarships for specialised trainings for key course based on Skills Assessment Plan	500,000
3	Targeted training advocacy for (policy makers, planners, and practitioners) on CC adaptation planning and implementation and integration through climate training programs and training of trainer programs	100,000
4	AV products for broadcast, print and online/social media developed and delivered.	300,000
5	Develop and conduct grassroots advocacy program on climate risks and adaptation, particularly for vulnerable communities and groups	600,000
SUB TOTAL OF EDUCATION AND AWARENESS		1,800,000
TOTAL OF DETAILED ADAPTATION PRIORITIES		13,944,553,158
TOTAL OF ENABLING ACTIVITIES		14,845,000
TOTAL		13,959,398,158

SUMMARY OF SECTOR WISE FINANCING NEED		
Sl.No.	Name	Estimate in USD
DETAILED ADAPTATION PRIORITIES		
1	Water	204,896,900
2	Agriculture and livestock	95,215,000
3	Forest and biodiversity	48,470,000
4	Human settlement and climate smart cities	13,088,922,705
5	Health	19,661,835
6	Energy	486,086,718
7	Climate services and disaster risk reduction	1,300,000
	TOTAL	13,944,553,158
DETAILED ENABLING ACTIVITIES		
1	Policy and institutional	645,000
2	Monitoring and Evaluation of NAP Process	800,000
3	Research and Data	10,300,000
4	Capacity building	1,300,000
5	Education and awareness	1,800,000
	TOTAL	14,845,000
	GRAND TOTAL	13,959,398,158

ANNEX 2: LIST OF CONSULTATIONS IN PREPARING THE NAP

NOTE: This chronology of consultations is only limited to the drafting of the 1st NAP document with the NAP Drafting Committee. This list does not include the consultations conducted for the background documents informing the NAP document prepared by the NAP Readiness Project.

Sl.No.	Activity	Date	Venue	Participants
1	Kick off meeting	14th May 2021	NECS, Thimphu	UNDP, WRCD, CCD and IC
2	Inception Meeting	28th May 2021	Virtual	TWG members
3	Presentation on Desk Review for NAP Drafting	9th August 2021	Norkhil Boutique, Thimphu	TWG Members
4	Bilateral meeting with DoA and DoL	18th August 2021	MoAF PPD, Thimphu	Representative from DoA and DoL
5	Bilateral meeting with MoH and KGUMSB	20th August 2021	MoH Conference Hall, Thimphu	Representative from MoH and KGUMSB
6	Bilateral meeting with DoFPS	19th August 2021	DoFPS Conference Hall, Thimphu	Representative from DoFPS
7	Bilateral meeting with WRCD	28th September	WRCD, NEC, Thimphu	WRCD team
8	Bilateral meeting with DHS, MoIT (erstwhileMoWHS)	29th September 2021	MoWHS Conference Hall, Thimphu	Representative from MOWHS
9	Bilateral meeting with Private Sectors	13th October 2021	BCCI, Thimphu	Private sector representative
10	DoA and DoL discussion on identification of adaptation priorities	30th August to 3rd September	Naksel Hotel, Paro	DoL and DoA representative
11	DoFPS and NBC discussion on identification of adaptation priorities	2-3rd September 2021	Lhayul Hotel, Haa,	DoFPS and NBC representative
12	MoH and KGUMSB discussion on identification of adaptation priorities	2-3rd September 2021	Drubchhu Resort, Punakha	MoH and KGUMSB representative

Sl.No.	Activity	Date	Venue	Participants
13	NAP drafting Workshop to discuss on identified priorities	21-22 October 2021	Drubchhu Resort, Punakha	TWG members
14	NAP drafting team meeting	12th November 2021	Rochogphel, Thimphu	WRCD, CCD, UNDP and IC
15	First Meeting of the NAP Drafting Committee	11th February 2022	Virtual	Drafting team members
16	Second Meeting of the NAP Drafting Committee	28th February 2022	Virtual	Drafting team members
17	Third Meeting of the NAP Drafting Committee	4th to 6th May 2022	Naksel Hotel, Paro	Drafting team members
18	Private sector and CSO consultation	20th May 2022	Norkhil, Thimphu	Representatives from Pvt and CSO sectors
19	CSO internal consultation on NAP priorities	4th June 2022	CSO hall, Thimphu	Representatives from CSO sectors
20	NAP drafting and review team meeting	15th to 17th June 2022	Kuenden Boutique, Thimphu	TWG members
21	NAP Project stock take meeting	22nd September 2022	Zasa, Thimphu	NEC, PMU, consultant
22	NAP, Drafting Committee meeting	7th October 2022	Norkhil, Thimphu	TWG members
23	NAP Drafting Committee meeting	12th October 2022	Norkhil, Thimphu	TWG members
24	1st Regional Consultation Meeting (Central Region)	19th October 2022	Swiss Guest House, Bumthang	NAP DC with dzongkhag level planners and experts (DT chairs and sector heads)
25	2nd Regional Consultation Meeting (Eastern Region)	21st October 2022	Druk Doethjung Hotel, Trashigang	NAP DC with dzongkhag level planners and experts (DT chairs and sector heads)
26	3rd Regional Consultation Meeting (Southern Region)	24th October 2022	Grand Kuku Hotel, Gelephug	NAP DC with dzongkhag level planners and experts (DT chairs and sector heads)
27	4th Regional Consultation Meeting (Western Region)	27th October 2022	Drubchu Resort, Punakha	NAP DC with dzongkhag level planners and experts (DT chairs and sector heads)
28	National level consultation on NAP at executive level	28th October 2022	Le Meridien Hotel, Thimphu	NAP DC with heads of National Agencies,

Sl.No.	Activity	Date	Venue	Participants
				representatives of CSO, private sector, Donor Agencies.
29	Bilateral Adaptation Priorities for human settlements with MoIT (erstwhile MoWHS)	2nd Nov 2022	MoIT Conference Hall, Thimphu	NEC, PMU, MoIT (erstwhile MoWHS), Consultant

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Consultation on the Draft National Adaptation Plan for Central Region
Date: 19th October 2022
Venue: Swiss Guest House, Bumthang

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Consultation on the Draft National Adaptation Plan for East Region
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Venue: Druk Deothjung Hotel, Trashigang

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Consultation on the Draft National Adaptation Plan for South Region Date: 24th October 2022 Venue: Kuku Grand, Gelephu					
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Consultation on the Draft National Adaptation Plan for West Region
Date: 27th October 2022
Venue: Drubchu Resort, Punakha

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ANNEX 3: KEY MESSAGES FROM REGIONAL AND NATIONAL CONSULTATIONS ON THE NAP

A summary of key messages from the national consultations (Thimphu) and four regional consultations (Bumthang, Trashigang, Gelephu, and Punakha) on the NAP conducted between 19-28 October 2022 is presented below.

Planning and implementation:

Successful adaptation requires collaboration in bottom-up and top-down approaches. For successful integration of adaptation in development planning in Bhutan, the Mainstream Reference Group (MRG) needs to be revived at national and local levels.

- *Collaboration.* Climate change impacts all sectors and working collaboratively at all levels, from local government (LG) and districts to central levels would help avoid duplication and provide cost efficiency of investments.
- *Mainstreaming climate change adaptation*: There was overwhelming support for enhancing mainstreaming of climate change by reviving the Mainstreaming Reference Group (MRG) at the national level. In addition, establishing Local MRGs along with capacity building would help ensure integration of Gender, Environment, Climate, Disaster and Poverty (GECDP) concerns into development planning at both central and local levels.

Systems thinking and a coherent and coordinated approach is required for cost-effective, and efficient implementation of adaptation and development priorities.

- *Cost-effective and efficient adaptation:* integrating climate change into development plans at both central and local level would help approach adaptation systematically, cost effectively and through an integrated approach. An integrated, coherent, and collaborative approach can minimise duplication and wastage of resources for adaptation.
- ***Integrated approach***: the 'whole of society' approach in climate change adaptation planning and implementation needs to be continued. This would help ensure climate change is approached through an integrated approach.
- ***System thinking and no regret action***: The increasing demand for climate resilient infrastructure calls for better planning through 'system thinking' approach. A 'whole of society' approach in climate change adaptation planning and implementation needs to be continued. Better planning of roads and settlements to avoid risky places, design of roads, supply, and sanitation infrastructures, build back better (replacement) and operation and maintenance of infrastructure (aimed at fast recovery) would help ensure lives, livelihoods and livelihood assets are protected.

Maladaptation can be avoided through collaboration, coordination, and integrated approaches and awareness.

- *Avoiding unintended consequences*: Avoiding maladaptation should also be given priority when planning for improving access to water.
- Coordination and information to avoid maladaptation. Integrated approach to planning with enhanced coordination and cooperation and by considering the best available information is necessary to avoid maladaptation.

- *Awareness and capacity enhancement*: Capacity development at all levels from LG to districts, central agencies, academia, private sector and CSOs would yield better results and avoid maladaptation.
- False sense of security from adaptation. Placement of Early Warning Systems should not be a pretext to continue investments in hazard-prone areas as these can lead to maladaptation.

In addition to addressing adverse impacts of climate change take advantage of any positive benefits from climate change to improve livelihoods and resilience.

- *Opportunities from positive impacts*: While climate change will bring about largely adverse impacts, adaptation interventions should also respond to any positive impacts that may arise such as increase in potential crop growing areas.
- *Climate resilient varieties for agriculture*: Developing and promoting climate resilient varieties of poultry, small livestock and cattle would provide alternative sources of livelihood.

Research at local level in priority areas such as water resources and ecosystems is essential to make informed decisions and adaptation plans.

- Informed decision making: Water availability is a critical issue and adequate research should be carried out to make informed decisions in planning interventions. Climate resilient infrastructure for irrigation and drinking water should be based on water discharge analyses.
- Urgent studies: Research on role of forests, spring sheds, watersheds and ground water in water availability needs to be urgently studied.

Implementation approaches and synergies:

Ecosystem based approaches is essential for adapting to climate change impacts on water resources. Ecosystem based approaches also means ensuring minimal environmental impact from adaptation interventions.

- *Ecosystem-based approach*: spring-shed conservation can be effective for drying of springs. Restoration of wetlands and lakes/ponds would help ensure storage of water and slow recharge of underground aquifers.
- *Environmental impacts of adaptation actions*: Maintain environmental flow such as water for wildlife when enhancing irrigation and drinking to avoid unintended consequences.

Infrastructure development and resilient human settlements should use ecosystem-based approaches and "green infrastructure" to ensure synergistic benefits for liveable and resilient human settlements.

- *Green infrastructure for urban and rural resilience*: 'Green infrastructure' such as green open spaces and critical watersheds would be required going forward to make our towns and villages liveable, climate resilient and beautiful.
- *Build better forward*: Going forward, designing, and implementing climate resilient infrastructures- roads, civic amenities, hospitals, schools would help save lives, livelihoods, and livelihood assets.

Disaster risk management and early warning systems are essential and should be a priority as climate induced disasters are becoming more frequent.

- *Disaster risk management*: Climate induced disasters such as flash floods, landslides, windstorms, floods are becoming more frequent. Further the rapid pace of our socio-economic development is adding to the pressures. Given this disaster risk reduction is essential for climate change adaptation.
- Early warning systems: continue investment in Early Warning System (EWS) and weather forecasts improvements to save lives and livelihood assets. However, EWS should not however be a pretext to continue investments in hazard-prone areas.

Implementation/financing:

Clear guidance and information on climate financing including availability and allocation is required for successful integration and mainstreaming of adaptation or mitigation.

- *Funding for additional adaptation vs business-as-usual development*: Clear guidance and information on resource availability and allocation is needed when mainstreaming climate change at different levels.

Diversification and innovative sources of financing at national to local levels as well as in financial services and private sector can enhance climate resilience and financing.

- *Alignment across financial, development and climate sectors*: Alignment with ongoing national initiatives such as 21st Century Economic Roadmap and Green Financing Guidelines, RMA, the 21st century economic roadmap linkage and the 13FYP. The Green Taxonomy in the Green Financing Guidelines of RMA is created to support implementation of climate change mitigation and adaptation actions through financial institutes and there should be alignment between the RMA-led initiative and the NAP.
- *Payment for ecosystem services (PES)*: proper education/awareness for watershed/spring-shed management is required to ensure continuation and sustainability of PES to incentivise natural resources stewardship by local communities.
- *Achieving self- sufficiency critical to achieving climate resilience*. Investments in community-based micro- and pico-hydro power generation would help achieve climate resilience by diversifying from large and medium hydro.

Key stakeholders, their strengths and capacity needs:

There is need for greater awareness and capacity building for climate change and integration with development at local level.

- *Local level capacity building is needed*: Climate change impacts hit the local level the hardest. The demand for climate change adaptation therefore is more there and focus on addressing capacity needs of LG staff.
- *Awareness and capacity enhancement is required at all level and sectors*: investment in capacity development at all levels- from LG to Districts to Central agencies, academia, private sector, CSOs would yield better results and avoid maladaptation.
- *Factoring climate change at local levels*: capacity building at local level would help enhance skills to better understand vulnerabilities at local level, prepare communities and approach local development through factoring climate change.

It is important to identify and engage appropriately with key stakeholders based on their roles, knowledge, experience, and capacity. Key stakeholders can include the right technical experts, community elders and leaders, the private sector and civil society.

- *Applying the right skills*: Infrastructure for most local level investment is designed by district engineers, but capacity gaps exist with engineers about climate resilient infrastructures. Guidelines for climate resilient infrastructure development and training on the use of the guidelines would ensure local infrastructure are climate proofed.
- *Using local and traditional indigenous knowledge.* Village elders and *tshogpas* are keepers of local and traditional indigenous knowledge and are key stakeholders for climate adaptation planning and implementation. These critical traditional and indigenous knowledge and autonomous adaptation skills should also be recorded and transferred.
- *Private sector*: Private sector involvement is also important in climate change adaptation planning and implementation and their participation should be enhanced. The upcoming Green Financing Guidelines from RMA would help in this regard.
- *Role of civil society*: Civil society can be partners in delivery of climate actions to vulnerable groups and local level. In addition, CSOs also play an important role in monitoring implementation of adaptation by public institutions at all levels.

Education, awareness, and advocacy is a continuous process and should reach out to as many individuals as possible in society and the outreach should start early and with the right information.

- *Individual behaviour and actions*: Ultimately, it is individual responsibility and behaviour change that can lead to collective and effective change. Outreach and advocacy are necessary on a continuous basis to effect adequate cooperation in climate action and other related local priorities such as waste management.
- *Start early, start right*: Integrating climate change in school level curriculum would help maintain continuity on climate awareness and knowledge between school education and tertiary education. There is a concern that recent transformation initiatives might reduce prioritise economic plans over local impacts on environment and climate change impacts.

Monitoring and evaluation

A robust Monitoring and Evaluation of adaptation is essential to ensure effective implementation of the NAP, and to avoid maladaptation.

- *Precaution benefits*: A robust monitoring and evaluation (M&E) system for adaptation and to assess national, sectoral development plans and local development plans is imperative to track resilience and to avoid maladaptation and ill effects of development.
- *Iterative NAPs*: The M&E system for adaptation is also needed to clearly reflect achievements and gaps in NAP implementation so subsequent NAPs can be enhanced.

PART II:
DETAILED PRIORITIES AND NEEDS FOR ADAPTATION

DETAILED ADAPTATION PRIORITIES

1. WATER

The vulnerability of water resources is identified as one of the major climate risks in Bhutan and will affect all sectors, from food production, energy, human settlements, and the industry. The priorities in the water sector are therefore cross cutting across many sectors and stakeholder groups. The adaptation priorities in water sector take a holistic approach including nature-based solutions. The interventions from securing and managing natural sources of water to ensuring optimal use and management of water for drinking. Ensuring efficient and sustainable use of water for agriculture and other key infrastructure investments is also included for the water sector to ensure an integrated approach to water management. The management of water discharge after consumption for human needs is covered in the priorities for human settlements. The strengthening of institutional capacity for water management including enhancing existing institutions like water user groups, strengthening capacity of key stakeholders and continuing research is essential to support a continuous and iterative adaptation.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est Cost (USD)
1	Improve natural capacity for infiltration, water recharge, and water buffer for prevention of fast runoff and erosion.	Healthy and resilient functioning ecosystem for water services.	Ecosystem based adaptation to ensure natural capacity for water infiltration and recharge through; (i) Ecosystem restoration. (ii) Watershed management (iii) Promotion of traditional knowledge and	Assessment of wetlands, watersheds and spring sheds and development and implementation of intervention measures. Integrating of existing watershed management interventions into Local Area Plans/settlement plans and its implementation Restoration of existing water sources.	Effective implementation of water legislation and IWRM. Sustainable management of wetlands, watershed, and spring sheds. Conduct watershed modelling.	Number of wetlands, watersheds and spring sheds assessed and managed. Number of community awareness on IWRM and water legislations conducted (reports on implementation)	MoENR	LGs/ MoIT/ MoICE Relevant CSOs (Loden Foundn.)	500,000

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est Cost (USD)
			practices in water conservation.	Implementation of Ecosystem based Adaptation	Monitor infiltration, water buffers, fast runoff, and erosion.				
			Strengthen and upscale PES.	Strengthen and upscale PES. Review PES framework and field guide		Number of PES schemes upscaled	MoENR	LGs	100,000
2	Optimal use of available water discharge	Robust water resources planning and monitoring system.	River basin planning.	Conduct feasibility studies to build emergency storage, bypasses, and controlled releases from glacial lakes. River basin management and planning for basin optimization.	Build emergency storage, bypasses and controlled releases from glacial lakes if found feasible. Monitoring and evaluation of river basin management plan	Number of feasibility studies conducted to build emergency storage, bypasses, and controlled releases from glacial lakes. Number of river basin management plans prepared and implemented	MoENR	NCHM/ LGs/ MoICE, MoIT	62,000
			Promotion of water efficient technologies	Enhance research and development on water efficient technologies. Conduct advocacy on water efficient technologies		No. of publications on water efficient technologies Number of advocacy programs conducted	MoENR	RUB, MoIT, MoAL or LGs	23,500

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est Cost (USD)
3	Ensuring climate resilient supply of safe drinking water under climate change.	Improved access to safe drinking water.	Ensuring proper monitoring, planning and supply of drinking water	Assessing the efficiency of existing water treatment facilities and water supply network systems. Explore alternative water supply technologies. Expand the implementation of Water Safety Plans (WSPs) and proper water supply systems with adequate design. Awareness programs for efficient water use. Provide training on plumbing water management and other related skills. Develop operation and maintenance guideline and standard	Explore and improve water treatment and supply network systems with proper management mechanisms. Explore and build additional storage facilities.	Households/Institutions with safe drinking water. Water supply duration and quality improved. Number of WSPs strengthened and implemented. Number of awareness program conducted. Number of officials trained on plumbing water management and other related skills. Operation and maintenance guideline and standard published	MoIT, MoH	MoH, LGs, MoENR OYE	12.3 million
			Harvesting rainwater/fog for domestic use	Exploring volume of rainwater generated at water stressed areas for domestic use. Developing assessment guide for integration of	Integrating rainwater/fog harvesting structures into buildings and other amenities	Assessment guide for integration of holistic use of water resources developed	MoH, MoIT, RUB	MoENR Relevant CSOs (Tarayana etc)	0.2 million

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est Cost (USD)
				holistic use of water resources					
			Reduction of Non-Revenue Water losses	Study of NRW in critical areas.	Implementation of improvements to reduce NRW.	% of NWR reduced in Thromdes	MoIT	LGs, MoENR	6.5 million
			Strengthen drinking water quality monitoring and surveillance	Strengthening laboratory services to test and monitor water quality	Strengthening water quality and monitoring information systems	No. of additional water quality parameters included in monitoring. Integrated water quality and monitoring system established. # of water quality assessment reports published ISO certification ascertained	MoH	MoIT, LGs, MoENR	
			Strengthen database/inventory on drinking water supply schemes		Establishment of a real time water supply monitoring system	Functional real time water monitoring systems in place	MoIT, MoH	LGs, MOENR	4 million
4	Enhance water use efficiency and promote sustainable	Improved resilience of irrigation infrastructure	Improve planning, designing and implementation of climate resilient irrigation	Climate proofing of the irrigation facilities (HDPE/concrete)	Climate proofing of the irrigation facilities (HDPE/concrete)	Number of climate proof irrigation schemes developed (45 schemes)	DoA	LG, CSOs	70 million

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est Cost (USD)
	management of water resources for agriculture		infrastructures and systems						
				Exploring alternative means of irrigation (solar pumps and lift irrigation)		Number of lift irrigation system initiated	DoA	LG	
			Strengthen database/inventory on irrigation schemes	Development of irrigation schemes database system	Conduct modelling and simulations of discharge for proposed irrigation schemes	Database on irrigation systems developed. Number of discharge modelling and simulation conducted for proposed irrigation schemes	MoAL	NCHM	
5	Strengthen institutional capacity for water management	Robust water resources planning and monitoring system.	Strengthening Water User Associations (WUAs).	Review and strengthen WUAs. Implementation of WUA guidelines. Training on IWRM, formation of WUA and legalization, (management, accounting, etc.).	Monitoring and evaluation of WUAs.	Number of functional WUAs that are formally registered. Number of trainings for WUAs conducted	MoENR	Relevant CSOs (Tarayana, Bhutan Toilet, OYE, OPD)	18,000
			Strengthening research on water resource management including	Research on water resource management including groundwater resources and soil moisture	Initiate use of groundwater or discontinue based on	Number of studies on groundwater resources conducted	MoENR	NCHM/RUB	25,400

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est Cost (USD)
			groundwater resources.	Enhance hydrological and groundwater modelling. Carry out studies on the options for household/institution level rainwater harvesting or creating additional water storage capacity. Assess climate risk on water intensive industries (168 water intensive industries as of 2022)	findings from the study.	Real time information on soil moisture in place			92,000 16,000 75,000
			Enhancing capacity of key stakeholders in managing the impacts of climate change on water	Capacity development on climate resilient water infrastructures Training onsite inspection, Aerial survey using Drones and mapping using GIS	Capacity development on climate resilient water infrastructures	No. of officials trained on climate resilient infrastructure design and construction. No. of officials trained on aerial survey using drones	MoIT, MoAL,	MoICE, MoH, Relevant CSOs	135,000
				Capacity development of flood and storm water management from river flooding and urban floods.		No. of officials trained in assessment and drafting of flood and stormwater management	FEMD, DES, (MoIT)	Relevant CSOs	150,000
				Capacity development to generate forecast	Information disseminated on timely basis to	Number of officials trained to generate forecast	NCHM	Relevant CSOs	

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est Cost (USD)
				information at sub-basin level so that early warning. information is disseminated on timely basis to all sectors/communities. at suitable temporal (Daily to seasonal) and spatial (from river basin to sub-catchment) scale.	all sectors/ communities. A robust real to near real time information dissemination system with customizable to requirements of different sectors.	information at sub-basin level. A Real to near real time weather and water availability information dissemination system in place.			
				Build capacity for decision making and management of critical communication infrastructure, through development of Road Asset Management System (RAMS), Develop Decision Support System, GIS and other tools	Continuous updates for technology and refresher training.	No. of officials trained	DoR, MoIT	Relevant CSOs	

2. Agriculture and Livestock

Agriculture and livestock sector is an important sector for Bhutan with 51% of the population employed in agriculture and contributing about 17% of GDP. While food security is a key national priority, climate change impacts such as changes in water availability, increasing pests presents risks to the sector. The adaptation priorities for both agriculture and livestock are grouped in interventions for securing the resource base, managing losses from climate impacts and emerging threats, and enhancing resilience in food production. The interventions include integrated landscape approaches including sustainable land management, appropriate technologies, and management practices.

The agriculture and livestock sector presents strong synergies for climate mitigation trough landscape approaches such as agroforestry, sustainable soil and land management, promotion of organic and good agricultural management practices. The role of the private sector is identified in several areas of food production, market access, supply chain for the sector and risk management. Opportunities for integration of gender issues through appropriate technologies and engagement of women's groups are also identified. Recent lessons from the COVID-19 pandemic such as risks in supply chain, food banking and risk of zoonotic events have also been integrated. Targeted training at sector and the decentralised level is also required for enhanced risk assessments and adaptation implementation.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collaborating Agency	Est. cost (USD)
1	Securing the natural resource base for livestock grazing feed and fodder sources	Reduced vulnerability of livestock farmers	Efficient utilization of alpine rangeland and development of agroforestry systems for livestock	Identify and set up permanent research plots to study the impact of climate change on diversity of grasses in rangeland Improve alpine rangeland governance system	Continue research and monitoring	Establish four permanent research plots in four regions for long term research and monitoring. 1 rangeland management guideline developed	DoL	NLCS/ DoFPS/ DoA/ DoLGDM	40,000
				Sustainable management and utilization of alpine rangeland resources	Sustainable management and utilization of alpine rangeland resources	Restoration and maintenance of 10,000 acres of	DoL	NLCS/ DoFPS/ NHRDC/ NRDCAN	2,000,000

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collaborating Agency	Est. cost (USD)
						alpine rangeland pastures			
				Mapping and identification and assessment, of indigenous forage/grass species		Indigenous grass identified, and rangeland pastures mapped for 12 highland Dzongkhags	DoL	DoFPS/ NHRDC/ NRDCAN/ NLCS	140,000
			Enhanced availability of feeding resources through agro-forestry system	Promote resilient fodder tree plantation. Promote production of local feed raw materials	Continue and upscale resilient fodder tree plantation Expand acreage for raw feed material production	One million fodder trees planted (9174 acres x109 trees/ac) Reduced dependence on imported feed raw materials	DoL	NRDCAN/ DoFPS	3,000,000
				Promote pasture under agro-forestry system (orchard, silvo pastoral)	Promote pasture under agro-forestry system (orchard, silvo pastoral)	400 acres of pasture under orchard/forest system developed (400 x 25,000)	DoL	DoA/ NRDCAN/ RLDCs/ DoFPS	133,000
				Upscale usage of crop residues through enrichment and fodder conservation	Upscale usage of crop residues through enrichment and fodder conservation	2,000,000 MT of forage and crop residues enriched and conserved	DoL	DoA/ NRDCAN/ RLDCs	130,000

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collaborating Agency	Est. cost (USD)
2	Enhancing resilience and livestock production through appropriate technologies and management practices	Enhanced adaptive capacity of livestock farmers and the livestock sector by increasing sustainable production	Conservation and promotion of climate resilient native livestock breeds	Conservation and development of native poultry breeds	Continue program for Conservation and development of native poultry breeds	2 numbers of native poultry strain selected	DoL	NPRDC/ NBC	200,000
				Conservation and development of native piggery breeds	Continue Conservation and development of native piggery breeds	1 native piggery conservation farm established	DoL	NPiRDC/ NBC	200,000
					Development of suitable Bhutanese cattle breed through cross breeding	2 suitable livestock breeds developed	DoL	NDRDC	100,000
					Promotion of advanced livestock reproductive technologies (Sex sorted AI, ET,) for enhanced dairy productivity	200 viable embryos transferred. 5,000 progenies born from sex sorted semen AI	DoL	NDRDC	100,000
			Promote climate smart livestock farming practices	Promote Effective Microorganism Technology (EMT) in poultry and piggery farms		EMT implemented in 200 poultry and 150 semi	DoL	DLS/ NPRDC/ NPiRDC/ NRDCAN,	350,000

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collaborating Agency	Est. cost (USD)
			through gender- and PWD-friendly farm-level technologies.			commercial piggery farms		Farmer groups and cooperatives, private sector	
				Fencing on pastureland to reduce incidence of wildlife depredation on livestock		1,000 acres of pastureland e-fenced	DoL	DoFPS/ DoA/ NRDCAN, Farmer groups and cooperatives, private sector	$1m
				Improve micro-climate conditions in animal sheds		Solar fans, sprinklers, and lighting in 5 farms in sub-tropical region, solar heating, and lighting system in 5 temperate farms	DoL	Farmer groups and cooperatives, private sector, relevant CSOs like Loden and Tarayana	700,000
				Expand apiculture for boosting honey production and enhance crop productivity	Expand apiculture for boosting honey production and enhance crop productivity	5,000 free flow honey hives promoted on cost sharing basis	DoL	NHRDC/ DLS/ DoA Farmer groups and cooperatives, private sector, relevant CSOs like Loden and Tarayana	2,000,000

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collaborating Agency	Est. cost (USD)
				Water efficient and low-cost fodder production during lean season (hydroponics)		100 numbers of low-cost hydroponic facilities established	DoL	NRDCAN/ NHRDC, Farmer groups and cooperatives, private sector, relevant CSOs like Loden and Tarayana	300,000
				Promote heat and cold resistant fodder varieties		Identify and introduce 3 numbers of heat and cold resistant fodder species	DoL	NRDCAN	30,000
				Adopt labour saving devices and equipment to reduce drudgery on women and vulnerable groups	Scale up labour saving devices and equipment to reduce drudgery on women and vulnerable groups.	200 numbers of chaff cutter, automatic feeding and milking systems installed in women led household	DoL	DLS Farmer groups and cooperatives, private sector, relevant CSOs like Loden and Tarayana	200,000
			Efficient utilisation of natural water bodies and land resources to boost fish production	Expand community-based capture fisheries.		Develop and hand-over two (2) community-based capture fisheries to the communities	DoL	NRDCRLF/ DoFPS	50,000

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collaborating Agency	Est. cost (USD)
					Explore cage culture fisheries in inland water bodies and hydropower dams	Develop management plan and pilot two (2) cage fisheries in Hydropower dams	DoL	NRDCRLF/ DHI/ DGPC/ DoFPS	100,000
				Explore and introduce low-cost fish production technologies (aquaponics)	Explore and introduce low-cost fish production technologies (aquaponics)	Pilot and establish 5 aquaponic/biofloc fish production facilities	DoL	NRDCAN/ RLDC	133,000
			Utilization of spatial information, remote sensing, and ICT for delivery of efficient and effective livestock services	GIS application for livestock development (to map migratory cattle and yak herds)		2 nos. (cattle and yak) of migratory herds mapped	DoL	NHRDC/ DLS	100,000
				Digitalization to generate real time data for informed decision making	Digitalization to generate real time data for informed decision making	Realtime meteorological data recording instituted in livestock farms	DoL		50,000

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collaborating Agency	Est. cost (USD)
3	Managing livestock losses from climate change impacts and emerging threats	Reduced vulnerability of livestock farmers against losses from climate change impacts	Strengthen surveillance and forecasting system for prevention and control of emerging animal diseases and threats under climate change	Strengthen capacity of livestock research centres and laboratories to address emerging threats from climate change impacts	Strengthen capacity of livestock research centres and laboratories to address emerging threats from climate change impacts		DoL		3,000,000
				Institute recording and reporting system on livestock lost due to climate induced extremes		Develop, sensitize, and implement reporting system on livestock lost due to climate extremes	DoL	DLS	33,000
				Improve farm biosecurity	Awareness	Implement farm bio security SOPs in 20 livestock farms and 30 commercial poultry and piggery farms	DoL	NCAH/ BAFRA	33,000
				Strengthen transboundary animal disease reporting and management system		Improve the existing TADS	DoL	NCAH	10,000

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collaborating Agency	Est. cost (USD)
				Initiate herd health management		Implement herd health management in 100 commercial livestock farms	DoL	NCAH/ RLDCs	50,000
				Promote and popularize traditional knowledge and practices for safe and sustainable livestock production	Awareness	Identify, promote, and prescribe 10 ethno-veterinary practices	DoL	NCAH/ RLDCs	33,000
4	Enhance water use efficiency and promote sustainable management of water resources for agriculture	Improved resilience of irrigation infrastructure	Improve planning, designing and implementation of climate resilient irrigation systems at farm level	Promote adoption of micro irrigation (Drip, sprinkler) by increasing accessibility to farmers through simple, affordable, and smart technology	Promote adoption of micro irrigation (Drip, sprinkler) by increasing accessibility to farmers through simple, affordable, and smart technology	Number of HH adopting micro-irrigation systems (100 households every year)	DoA	LG Farmer groups and cooperatives, private sector, relevant CSOs like Loden, Tarayana, RSSC	$5m
				Rehabilitation of the traditional irrigation system to reduce water loss through climate proof structures integration		Number of irrigation system rehabilitated (20 major irrigation schemes)	DoA	LG	
				In-situ water harvesting - diverting, inducing, collecting, storing, and conserving local surface runoff, spring water and		Number of water-harvesting structures constructed (25 structures, i.e 5	DoA	LG	

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collaborating Agency	Est. cost (USD)
				rainwater for agriculture production		structures every year)			
					Explore tail water management and usage.	Length of drainage system constructed for tail water management			
5	Pursue an integrated landscape approach for sustainable soil and land management for agriculture	Increased resilience of the land and ecosystem for food production and nutrition security	Promote and upscale sustainable land management (SLM) programs through enhanced technologies	Improve soil carbon, health and fertility through adoption of improved and integrated soil nutrient management practices		-Area brought under improved soil carbon (2,000 ha) -No. of soil health assessment completed (10 No)	DoA/NBC	LG	$60m
				Residue management including bio-degradable mulching		Area under mulch (10,000 ha)	DoA	LG	
				Agriculture land development		Area brought under sustainable land management (10,000 ha)	DoA	LG	
				Mapping of degraded areas, and soil erosion	Mapping of degraded areas, and soil erosion	Mapping completed by 2026	DoA	NLC, LG	

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collaborating Agency	Est. cost (USD)
				Establish soil organic carbon monitoring, accounting, and reporting under different crop land			DOA	NSSC, LG	
			Development of integrated agriculture landscape system approach	Promote Bhutan Good Agriculture Practices (GAP) and GMP	Promote Bhutan Good Agriculture Practices (GAP) and GMP	No of HH adopting Bhutan GAP (5,000 hh)	DoA	DAMC, BCCI, BAFRA, Farmer groups and cooperatives, private sector,	
				Strengthen Bhutan GAP certification process	Continue Bhutan GAP certification process	No of Bhutan GAP certified products (10 products)	DoA	DAMC, BCCI, BAFRA, DCSI, LG Farmer groups, cooperatives, private sector	
				Promote perennial crop (fruits & plantation crops production to enhance small holder farm income and improve climate resilience production system	Promote perennial crop (fruits & plantation crops production to enhance small holder farm income and improve climate resilience production system	Area under perennial crops (15,000 ha)	DoA	DoL, DoFPS, LG Farmer groups, cooperatives, private sector	
6	Managing food prodcution losses from climate change impacts and	Reduced vulnerability of farmers against losses from climate	Institute pest surveillance systems and strengthen	Strengthen pest surveillance system and diagnostic facilities		Pest surveillance system strengthened and functional by 2026	DoA	WFP, IFAD,	$2m

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collaborating Agency	Est. cost (USD)
	emerging threats	change impacts	diagnostic facilities			Lab facilities strengthened			
				Develop and Promote Integrated Pest Management technologies		No of IPM technologies promoted (10 nos.)	DoA	LG	
			Promote sustainable practices and innovative solutions to reduce crop loss, food waste and improve post-harvest technologies through improved value chain development to enhance resilience of farmers	Develop efficient post-harvest infrastructures and distribution system.		No of post-harvest infrastructures and distribution system established. (15 Nos)	DAMC,	DoA, DoFPS, DoL, MOF, BCCI, BAFRA, LG, Private sector and financial institutes	$4m
				Promote cold storage facilities for agriculture products		No of cold storage facilities established (10 Nos, Capacity 100-300 MT)	DAMC		

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collaborating Agency	Est. cost (USD)
				Establish efficient cold chain facilities at strategic locations for livestock products	Establish efficient cold chain facilities at strategic locations	Cold chain and storage facilities at 3 strategic locations	BLDCL	RLDC/FCBL/ DoL,	
				Develop and promote local agro-diversity and knowledge-based products		No of local products promoted (10 products)	DAMC	- do-	
				Assessment of food/crop losses in the food value chain (harvest, storage, transportation, consumption)		Assessment report published by 2026	DoA	LG	
			Institute climate risk management for food production through insurance and compensation schemes covering climate change impacts	Initiate and promote insurance of livestock against wildlife depredation and extreme climate conditions	We suggest policies developed.	Compensation system introduced and implemented	MoAL	DOFPS/ DLS/ MOF/ Financial institutes, Environment and thematic group.	$4m
				Develop safety nets (example: Crop insurance and credit facilities) to cope		Crop insurance schemes initiated by 2026	MoAL	MOF/ Financial institutes, LG	

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collaborating Agency	Est. cost (USD)
				during extreme weather events					
7	Enhancing resilience and food production through appropriate technologies and management practices	Enhanced sustainable practices and innovative solutions for food production and management	Ensure women's/ Vulnerable group access to gender friendly technologies at farm level.	Adopt innovative, gender responsive technologies for smart climate resilient farming		Gender friendly technologies generated **(20 technologies)**	-DoA	LG, NCWC Farmer groups, cooperatives, private sector, relevant CSOs like Loden, Tarayana, BAOWE, BNEW, RENEW	$1.5m
			Explore, develop, and promote climate resilient crop varieties and climate smart technologies to improve sustainable production systems	Inventory/improve and promote climate resilient indigenous varieties to adapt to climate change impacts	Inventory/improve and promote climate resilient indigenous varieties to adapt to climate change impacts	No of land races screened (30 nos)	DoA	CGIAR institutes, LG	$2m
				Generate/develop/breeding and promote climate resilient crop varieties	Generate/develop/breeding and promote climate resilient crop varieties	No of heat, drought, cold tolerant, pest and disease resistant varieties	DoA	LG	

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collaborating Agency	Est. cost (USD)
						promoted (50 nos.)			
				Increase cropping intensity through intensive climate smart cultivation systems (greenhouse, hydroponics, aeroponics, vertical farming)	Increase cropping intensity through intensive climate smart cultivation systems (greenhouse, hydroponics, aeroponics, vertical farming)	No of protected structures constructed (15,000 nos.)	DoA	LG	
				Generate/develop and promote and diversify nutri-dense crop varieties	Generate/develop and promote and diversify nutri-dense crop varieties	Area under nutri-dense cereals (increase by 3000 ha)	DoA	LG, NBC	
				Promote energy efficient and gender friendly farm machineries	Promote energy efficient and gender friendly farm machineries	No of gender friendly farm machineries (1000nos)	DoA	NCWC, Farmer groups, cooperatives, private sector, relevant CSOs like Loden, Tarayana, BAOWE, BNEW, RENEW	
8	Conduct targeted training at sector and decentralized level for enhanced assessment and	Targeted and enhanced capacity building for adaptation for food security	Assess capacity needs for adaptation planning and implementation	Conduct capacity needs assessment (HR, infrastructure & equipment) of relevant government institutions, SOEs and communities for climate change adaptation.		Needs assessment completed	DOL	NEC Relevant CSOs like Tarayana,	$0.5m

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collaborating Agency	Est. cost (USD)
	implementation of adaptation								
			Targeted training on impacts of climate change in food production at sectoral to community levels.	Capacity building of technical officials on climate change impact on agriculture productivity and food security - including farm household models for strong decision making		No of training conducted (15trainings conducted)	DoA	NEC, RUB Relevant CSOs	$2m
				Capacity building of livestock field staff and farmers	Capacity building of livestock field staff and farmers	250 staff and 205 farmers including LGs trained on various climate change adaptive measures	DOL	NEC	

3. Forests and Biodiversity

Bhutan's forests cover most of the country's land area (70.77%) and is a major factor in Bhutan achieving carbon neutral status. The forests are also a source for natural resources such as timber, non-wood forest products and other ecosystem services including as a store for fresh water. Furthermore, the different forests provide a variety of habitats for the rich biodiversity of Bhutan. Climate change poses great risk to forests and biodiversity, through potential changes in habitats and ecosystem functions. The increasing risks of forest fires due to drier and warmer winters not only threaten biodiversity but could also jeopardise Bhutan's carbon sinks.

The adaptation priorities for forests and biodiversity are developed in a highly synergistic approach and contributes to mitigation (carbon sink management) in line with the National REDD+ Strategy (NRS), biodiversity conservation in line with the National Biodiversity Strategy and Action Plan (NBSAP), and disaster risk management. The interventions also aim to engage communities, private sector, and vulnerable groups as partners in management of the natural resources through people-centric programs. Opportunities to integrate gender responsive measures have also been included to the extent known and possible.

The adaptation priorities address the great risk from forest fires, enhancing the assessment and monitoring of biodiversity under climate change, along with restoring and managing important areas and components of biodiversity in Bhutan. Invasive alien species and other emerging risks like zoonosis and spread of pest and diseases have also been identified in the wake of the COVID-19 pandemic. Key interventions also include management of forest and biodiversity through scientific sustainable management and community engagement.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est. Cost (USD)
1	Strengthen forest fire management in Bhutan through participatory and consultative approach	Minimized risk of forest fire	Develop and implement fire management strategies and plans.	Develop and implement the forest fire management strategy and plans	Continue implementation of the plan	Number of plans developed, and strategies implemented	DoFPS	DoLGDM, LG, First responders NGOs, Local communities,	1 M (ST) 0.5 M (MT)

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est. Cost (USD)
			Strengthen response capability on forest fire management	Conduct Capacity Need Assessment and build capacity.	Conduct periodic training on forest fire management for multi stakeholders	Number of people trained in forest fire management	DoFPS	DoLGDM First responders Pvt sector service & technology providers	0.4 M (ST) 0.5 M (MT)
				Upscale and strengthen the Dzongkhag level fire management interventions. Integrate Dzongkhag and local level fire management plans	Implement advance early warning systems	Response time and effectiveness	DoFPS	Dzongkags, DoLGDM	0.8 M (ST) 0.5M (MT)
				Strengthen forest fire surveillance and communication system (including forest fire suppression equipment)	Strengthen support for large fires and IFCG	Response time and effectiveness	DoFPS	DECC, DoLGDM, LG, First responders, Local communities	1.5 M (ST) 3 M (MT)
			Enhance awareness on forest fire management.	Develop awareness program/ materials and carry out awareness	Carry out awareness campaigns	Number of people made aware on forest fire and its impact	DoFPS	NEC, DoLGDM, LG, Media groups	0.05 M (ST) 0.02 M (MT)
			Strengthen adaptive forest fire management	Manage fuel load	Manage fuel load	Area brought under adaptive forest fire management	DoFPS	NRDCL, Local Communities, Private Sector	0.25 M (ST) 0.3 M (MT)

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est. Cost (USD)
				Carry out post fire habitat management	Carry out post fire habitat management		DoFPS	NRDCL, Local Communities, Private Sector	0.5 M (ST) 0.5 M (MT)
2	Enhance assessment and monitoring of biodiversity	Updated information on Biodiversity	Carry out long term monitoring of biodiversity and habitats	Develop capacity to monitor biodiversity and support implementation of Bhutan Biodiversity Monitoring Protocol	Continue support to implementation of biodiversity monitoring protocol	Number of people trained in biodiversity monitoring and robust biodiversity database system established	DoFPS	RUB,	0.10 M (ST) 0.20 M (MT)
				Strengthen existing database systems.	Updating the revamped database system		DoFPS	GovTech	0.05 M (ST) 0.05 M (MT)
		Changes in distribution of flora and fauna researched and documented	Build capacity to conduct national inventories and biodiversity surveys	Build capacity to conduct NFI and biodiversity survey	Develop database systems and implement the database to document and monitor	No of database developed/implemented, No. of research/studies conducted	DoFPS	RUB	10.5M (ST) 0.5 M 9MT)
			Conduct periodic National Forest Inventory	Develop NFI database	Develop capacity to conduct NFI and data analysis	NFI conducted	DoFPS		0.3 M (ST) 0.2 M (MT)
					Procure equipment and conduct NFI		DoFPS	MoF, NSSC, FAO	4 M (MT)
			Develop a dynamic technology system to track the real time forest cover change	Develop and implement online National Forest Monitoring Portal to	Integrate National Forest Monitoring Portal into the existing NFMS	National Forest Monitoring Portal developed and implemented	DoFPS	NLCS, DECC	0.3 M (ST) 0.2 M (MT)

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est. Cost (USD)
				monitor forest cover change on real time basis					
			Strengthen biodiversity assessment methodologies and techniques (molecular techniques for species delimitation)	Assess and enhance technical capacity and infrastructure	Implement molecular techniques and methodologies for biodiversity assessment	Molecular techniques and methodologies for biodiversity assessment introduced and implemented	NBC	MoENR	0.50 M (ST) 0.01 M (MT)
			Develop City Biodiversity Index	Stock-taking and identifying the baselines and developing the index	Regular monitoring and evaluation of the initiatives and awareness.	Number of Thromdes/Yenlag Thromde with Index	MoENR	LGs, NBC	
3	Identify, restore, and manage key important areas and components of biodiversity	Key important biodiversity conserved, and climate resilience value habitats improved	Enhance plantations and regeneration in SRF land	Develop suitable guidelines for plantations and regeneration in broadleaved forest		Total area of SRF regenerated (in Haa)	DoFPS	GBCL,NRDCL	0.02 M (ST)
				Assess existing plantations and formulate suitable plantation techniques and regeneration methods			DoFPS	NRDCL, GBCL, NGO, Communities	0.02 M (ST)

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est. Cost (USD)
				Carry out plantation in identified broadleaved forest (FMUs, LFMAs) and maintain these sites through community engagement	Carry out plantation in identified broadleaved forest (FMUs, LFMAs) and maintain these sites through community engagement		DoFPS	NRDCL, GBCL, Communities, LGs,	0.2 M (ST) 0.3 M (MT)
				Carry out reforestation in degraded areas in SRF	Maintenance of reforestation in degraded areas in SRF		DoFPS	NRDCL, GBCL, Communities, LGs,	0.2 M (ST) 0.3 M (MT)
			Rehabilitate habitats and carry out plantation	Identification and mapping of sites requiring restoration and rehabilitation		Total area of key important habitats and components of biodiversity managed (in Haa)	DoFPS	NBC, CSO, MBOs	0.1 M (ST)
				Carry out habitat management interventions such as enrichment plantations, grassland and alpine meadow management, salt licks, snags, waterholes, river back protections, etc. in identified areas	Carry out habitat management interventions such as enrichment plantations, grassland and alpine meadow management, salt licks, snags, waterholes, river back protections, etc. in identified areas		DoFPS, GBCL	Private Sector, NGO	0.3 M (ST) 1 M (MT)

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est. Cost (USD)
			Promote ex-situ conservation of species with high risk of extinction	Identification and mapping of fragile habitats and species		Number of species rescued and rehabilitated	NBC	DoFPS	0.03 M (ST)
				Develop and implement sustainable restoration plans.	Implement sustainable restoration plans.		NBC and DoFPS	DoFPS	0.05 M (ST) 0.15 M (MT)
			Develop legal framework for inclusion of wildlife movement friendly infrastructure to enable long term migration under climate change	Development of the legal framework	Approval and implementation of the framework	No of frameworks developed	DoFPS	NLCS, MoIT, NEC BES, WWF, RSPN	50,000
			Enhance Zero Poaching Strategy and reduce environmental crimes	Support to implementing the existing Zero Poaching Strategy	Revise and implement Zero Poaching Strategy	No. of Field offices implementing Zero Poaching	DoFPS	Other Law enforcement agencies (eg Judiciary, RBP, RBA, BAFRA, Customs) and Zhung Dratsang	1 M (ST) 1.2 M (MT)
4	Prevent and control the increasing incidences of zoonosis, pest and	Incidences of zoonosis, pest and diseases and IAS are	Strengthen surveillance and monitoring of zoonosis, pest, and diseases.	Identify and map areas prone to pests and diseases, and initiate periodic	Continue periodic monitoring and surveillance of the identified areas.	Number of strategies and plans on pests, diseases, zoonosis developed and implemented	DoFPS	NBC, MoH, DoL, RCDC	0.05 M (ST) 0.1 M (MT)

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est. Cost (USD)
	diseases and Invasive Alien Species (IAS)	minimized and managed		monitoring and surveillance					
				Project pest and disease spread through scientific modelling	Develop required mitigations/interventions based on the results from the monitoring.		DoFPS		0.05 M (ST) 0.1 M (MT)
				Develop pest and disease strategy and management plan, and support implementation	Continue implement pest and disease strategy and management plan.		DoFPS	NBC, MoH, DoL, RCDC	0.05 M (ST) 0.1 M (MT)
				Identify zoonotic diseases and implement strategic actions.			DoFPS	NBC, MoH, DoL, RCDC	0.05 M (ST) 0.1 M (MT)
				Support implementation of wildlife health strategy	Support to review the wildlife health strategy and continue to support implementation.		DoFPS	NBC, MoH, DoL, RCDC	0.1 M (ST) 0.1 M (MT)
				Develop capacity on GIS & RS, entomology, and Drone mapping	Develop capacity on GIS & RS, entomology, and Drone mapping		DoFPS	NBC, MoH, DoL, RCDC	0.1 M (ST) 0.4 M (MT)

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est. Cost (USD)
			Build capacity on assessment, control, and management of invasive species	Tools and equipment for control of alien species.	Implementation of the strategy	No. of strategy implemented	NBC	BAFRA, MOENR NPPC,	1.0 (action#1)
				Training on techniques for control of alien invasive species	Development of management plan for priority alien and invasive species outside protected areas.	No. of management plans developed outside PA/BC, No. of person trained	NBC/ DoFPS	BAFRA, NPPC, RUB	1
			Reduce the impacts of IAS on biodiversity forest ecosystem	Implement IAS management plan	Strengthen surveillance and monitoring of IAS.	Area brought under IAS management	DoFPS	NBC, BAFRA,NPPC, , PPD- MoAL, NBC	0.10 M (ST) 0.15 M (MT)
				Prevent introduction and establishment of IAS and manage existing IAS	Prevent introduction and establishment of IAS and manage existing IAS.		DoFPS/NBC	NBC, BAFRA,NPPC, , PPD- MoAL, NBC	0.05 M (ST) 0.1. M (MT)
5	Control and prevent degradation of forest cover and biodiversity through scientific sustainable management and	Livelihood of communities improved and their support towards conservation and sustainable forest management	Enhance landscape approach to conservation and promote alternative livelihood sources through nature-based solutions/adaptation	Support socio-ecological assessment of Transboundary Peace Park and support development and implementation of its management plan.	continue support to implementation of the management plan of the Peace Park	Number of landscapes conserved, and enterprises promoted	DoFPS	MoFAET , LG, Communities CSOs, MBOs etc	0.05 M (ST) 0.1 M (MT)

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est. Cost (USD)
	community engagement	enhanced in the Landscape							
				Identification of Other Effective Area Based Conservation Measures (OECMs) and development of plans for identified areas.	Implementation of the management action plans		DoFPS	NLCS, GBCL, NRDCL, DoA	0.3 M (ST) 0.5 M (MT)
				Support to implementation of the Human Wildlife Conflict Management (HWCM) Strategy	Revise and implement the HWCM Strategy.		DoFPS	DoA, LGs	1 M (ST) 1.5 M (MT)
				Support to implementation of the PA management plan	Support to revision of climate smart management plans of PAs and implementation.		DoFPS	MoAL, LGs,	0.5 M (ST) 1 M (MT)
				Promote Community Based Natural Resource Management (Community Forests, NWFP, Agroforestry)	Continue support to revision and implementation of CF, NWFP and Agroforestry plans		DoFPS	Communities (CFMG, NWFP), Private Sector, CSOs	0.5 M(ST) 1.0M(MT)
				Support to implementation of	Support revision of management plans of		DoFPS	NRDCL, LGs	0. 2 M (ST) 0.5 M (MT)

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est. Cost (USD)
				FMU management Plan	FMUs and implementation.				
				Promote PES as landscape approach to conservation	Promote PES as landscape approach to conservation		DoFPS	Communities, LGs, National agencies. Pvt sector	
				Support community-based cottage scale forest enterprises (NWFP, Wood, Ecotourism)	Continue to promote community-based cottage scale forest enterprises (NWFP, Wood, Ecotourism)		DoFPS	TCB, GAB, MoICE, BSB, HAB Communities (CFMG,NWFP) CSOs	1 M (ST) 0.5 M (MT)
			Develop and implement strategy for optimal utilization of timber resources.	Develop and implement strategy for development of wood-based industries to reduce timber wastage following circular economy concept	Develop and implement strategy for sustainable timber harvesting and utilization	Number of climate smart timber processing technologies promoted and adopted	DoFPS	MoICE, NRDCL, WBIs, Institute of Zorig Chusum	0.1 M (ST) 0.2 M (MT)
				Promote adoption of efficient and climate smart timber processing technologies to improve wood-based industries (WBI) to reduce wastage and	Promote adoption of efficient and climate smart timber processing technologies to improve wood-based industries to reduce wastage and		DoFPS	MoICE, NRDCL, WBIs Institute of Zorig Chusum	0.5 M (ST) 0.5 M MT)

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est. Cost (USD)
				maximize timber utilization.	maximize timber utilization.				
				Carry out capacity development program in timber processing, wood science and technology.	Carry out capacity development program in timber processing, wood science and technology.		DoFPS	MoICE, NRDCL, WBIs	0.2 M (ST) 0.3 M (LT)
			Promote people-centric biodiversity conservation and improve rural economy through Access and Benefit Sharing (ABS) Programs	Need assessment in natural product development and market analysis	Develop nature-based products to derive benefits and equitable sharing among rural communities	Number of products developed	NBC	DoFPS, State Owned Enterprises, Rural communities, CSOs/MBOs and Entrepreneurs	0.02 M (ST) 0.1M (MT)
				Infrastructure development (Lab and equipment's)			NBC	DoFPS, State Owned Enterprises, Rural communities, and Entrepreneurs	1.0 M (ST)
				Promote Access and Benefit Sharing (ABS) regime	Promote Access and Benefit Sharing (ABS) regime		NBC	DoFPS, State Owned Enterprises, Rural communities,	0.01M (ST) 0.02 M (MT)

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est. Cost (USD)
								and Entrepreneurs	
			Enhancing the use of local knowledge and beliefs for the conservation of biodiversity and forest	Documenting the traditional ecological knowledge to establish baseline environmental information.	Raising awareness on the use and importance of indigenous knowledge	Number of local knowledges documented, and awareness raised	DoFPS/NBC	LGs, Communities, CSOs	
		Forest enterprises developed to improve the livelihood of communities and reduce degradation of forests and conservation of biodiversity enhanced	Build technical capacity for Research and development in bioprospecting.	Human resource and infrastructure development. Procurement of laboratory equipment		No. of capacity developed	NBC	DoL, DoA, DoFPS NITM, Entrepreneurs, Existing national laboratories CSOs (Loden)	1M
				Research on phytochemical analysis and product development	Research on phytochemical analysis and product development	No. of product developed	NBC	DoL, DoA, DoFPS NITM, Entrepreneurs	0.5M

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est. Cost (USD)
								Existing national laboratories	
6	Ensure women's and other vulnerable groups assess to natural resources and capacity building	Increased access to resources and capacity building	Develop gender responsive natural resources access framework	Stakeholder consultation and drafting of framework	Implement gender responsive resources access framework	Gender responsive resources access framework developed	MoENR	CSOs (RENEW, OPDs, BNEW, BAOWE etc.)	0.02M
			Develop gender responsive capacity building plan	Stakeholder consultation and drafting of capacity building plan	Implement gender responsive capacity building plan	Gender responsive capacity building plan developed.	MoENR	CSOs	

4. Human Settlements & Climate Smart Cities

With a rapidly urbanising population, climate proofing existing urban areas and other critical infrastructure is essential as is preparing and implementing strategic plans for urban areas and human settlements. The priorities for the water sector are based on the detailed studies conducted for water in the NAP project, the 1st and 2nd NDCs, the Low Emission Development Strategy for Human Settlements and the Third National Communication. There are great synergies for mitigation and adaptation in urban areas and human settlements as already identified in these documents. For example, energy savings from residential and commercial areas due to energy efficiency and renewable energy generation (solar roofs) reduce the uncertainty of hydropower and function as both adaptation and mitigation measures. Securing ecosystem services in the form of '*green infrastructure*' around and within human settlements are nature-based solutions for both mitigation and adaptation.

The adaptation priorities for human settlements centre around developing climate smart cities and human settlements that leverages green infrastructure and ecosystem-based adaptation. Climate proofing existing critical infrastructure such as roads, bridges, houses, industrial areas, and agricultural infrastructure is also needed. Measures are identified to adapt to increasing floods, landslides, windstorms, and urban island heat effects. Besides hard infrastructure investments, soft interventions like risk assessments, research and data, policies and regulations and preparedness are also identified to enhance climate resilience in human settlements.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Estimated Costs (USD)
1	Develop climate smart cities and human settlements.	Sustainable and climate resilient human settlements	i) Strengthen institutional and policy environment to enable climate resilient planning and implementation	i) Review existing Guidelines on Planning and Development in Urban and Rural areas of Bhutan to minimize environmental impacts ii) Prepare climate resilient infrastructure master plans.	Climate-resilient infrastructure development Carry out geotechnical requirements in critical areas to assess any changes in the soil structure.	i) No. of guidelines developed ii) No. of climate resilient master plans prepared iii) No./ length of climate-resilient infrastructure designed and developed. Number of plans reviewed. Number of geotechnical investigations carried out.	MoIT MoIT MoIT	LGs, NEC, BTL, BPCL, Tashi Cell, BICMA	36,232 (Review and revision of guidelines) 253,623 (Preparation of Climate resilient master plans - Gelephu Thromde: 84,541 Phuentsholing

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Estimated Costs (USD)
				ii) Review Samdrup Jongkhar Urban Development Plan to incorporate climate resilient components: to implement the Pilot Project for Climate Resilience (PPCR) activities iii) Carry out geotechnical investigations to facilitate preparation of land use plans iv) Incorporate "build back better" including integration of mitigation priorities, health risk considerations and improving accessibility vi) Ensure operation and maintenance of infrastructure	Carry out periodic reviews. Carry out frequent supervision, upgradation if required including adopting enhanced technologies.	Number of related activities carried out. Frequency of supervision, maintenance reports, upgradation plans	Samdrup Jongkhar Thromde MoIT MoIT, MoH LGs	MoH LGs, DGM LGs, NEC	Thromde: 96,618 Samdrup Jongkhar Thromde: 72,464 60,387 (Revision of S/Jongkhar Urban Development Plan) 72,464 for Samdrup Jongkhar Thromde
			ii) Leverage "green infrastructure" for ecosystem-	i) Assess green infrastructure for ecosystem-based adaptation options	Integration and implementation of nature-based solutions in	No. of plans /activities carried outout.	MoIT	MoAL, NEC. LGS	USD 1m

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Estimated Costs (USD)
			based adaptation in urban areas.	for urban areas such as green spaces and buffer zones in line with LEDS for Human Settlements. ii) Prepare Transportation master plan for Thimphu iii) Strengthen implementation of no-build zones on riverbanks, green zones and other water channels with strict rules and regulations through enforcement of existing legislation (EA, Water and FNCA)	urban management Carry out periodic monitoring	No. of master plan prepared. Assessment report	MoIT MoIT	Financial institutions (risk management in red zones) Thimphu Thromde, Thimphu Dzongkhag LGs, MoAL, NEC	
			iii) Combat risk of Urban heat island	i) Implement green infrastructure plan as part of implementation of Thimphu structure plan. ii) Ensure/Green space; micro parks, avenue plantation, green building components in urban/town areas.		No. of parks, green to built-up ratio, plantation areas, green building components incorporated. No. of related activities carried out. No. of awareness activities carried out	Thimphu Thromde MoIT	MoIT, Thimphu Dzongkhag, BPCL, and others service providers LGs, MoAL	USD 20 million 6,039 (for workshops/awareness activities)

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Estimated Costs (USD)
				iii) Promote green building designs in line with LEDS for Human Settlements			MoIT	LGs, DRE (MoICE), Private sectors	
2	Build comprehensive database for urban areas	Comprehensive Geodatabase for housing, infrastructure including utilities, recreational areas and green spaces developed.	Strengthen database for housing, infrastructure and utilities, recreational areas, and green spaces	Develop Geodatabase for housing, infrastructure, utilities, recreational areas, and green spaces	Update the database	Housing database developed with geodatabase	MoIT	Thromdes	5,797,101 ((24,155 for each LG)
3	Enhance logistics preparedness for disaster management and improved service delivery	Enhanced logistics preparedness for disaster management including postal services	Enhance logistics preparedness for disaster management and improved service delivery	i) Develop Geocoded/Street Addressing for the Thromdes ii) Review Disaster Management and Contingency Plan for the construction and human settlement sectors	Update the System Carry out implementation of the action plan	Number of Thromdes with Street Addressing System Number of plans prepared with SOP and TAT	MoIT MoIT	Thromdes and Bhutan Postal Corporation LGs and relevant agencies	96,618 (24,155 for each Thromde) 144,928 (Revision of the Plan : 24,155 Implementation of the critical activities: 120,773)
4	Climate proof critical infrastructures and settlements	Safe, liveable, and resilient infrastructure in critical areas	Provide climate resilient infrastructure in critical areas for disaster risk reduction.	Review and develop flood and storm water management plans and Low Impact	Implementation of the climate resilient infrastructures, recommended in the flood and	No. of Dzongkhags/ Thromdes with flood and storm water management plans developed and implemented.	MoIT/ MoHA	LGs, MoAL MoICE, NCHM Red Cross OPDs, RSSC,	724,638 for drafting the Flood Management Plans (FMP)

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Estimated Costs (USD)
	against floods and landslides			Development Plans for urban areas. Review design of Flood protection management protective structures like dams, drainage systems, and barriers in flood-prone areas including in industrial/economic zones.	stormwater management plans. Monitoring and Evaluation of climate resilient infrastructures for disaster management	Monitoring report on CRIs.			For the implementation of FMP Mow- 7,487,923 Paro -2,814,010 Samtse- 1,449,275 Haa- 3,623,188 Punakha- 1,811,594 Thimphu- 6,038,647 Gasa- 1,811,594 3 other Dzongkhag/institution/ industrial estates- 12,077,295 For drafting the Stormwater Management Plan (SWMP)- 289,855 For implementation of SWMP Thimphu Thromde- 22,137,681 (SWMP is ready) Gelephu Thromde (SWMP will be ready by 2024)- 7,246,377 Samdrupjongkhar - 4,830,918 Phuentsholing Thromde- 6,038,647
			Strengthen windstorm management through	Enhance/improve disaster preparedness through		No. of officials trained	MoIT/ MoHA	LGs Construction Industry, RUB	114,734

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Estimated Costs (USD)
			capacity building and awareness.	infrastructure, capacity building, awareness and trainings based on Guidelines for Windstorm Resilient Roofing System					
5	Construct climate resilient road infrastructure	Climate proof transport infrastructure	Reduce risk of landslides from increased precipitation in critical zones	Construction of climate resilient road infrastructure Identification and mapping of perennial slope (including debris flow site) Assess landslide risk and develop	Introduction and implementation of flood/landslide resilient infrastructures Explore potential for	Km of roads constructed (176.8km) Km of road maintained (PNH-1,680.19 km SNH-1,169.74 km Dzongkhag Roads-2072.86 km Farm roads -11,258.2 km) as per 'Climate Resilient Road construction guidelines and standards' Area of slope sites identified and mapped. Nos. of slope stabilized. (Reotala, Dorjilung, Boxcut. Chengala,Leylang and Sonamjha)	MoIT MoIT	LG LGs, MoAL MoICE, RUB	117,149,758 (Construction of roads) 12,862,318,841 (Maintenance of roads) 2,415,459 (identification and mapping)

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Estimated Costs (USD)
				landslide management plans. Terracing or slope stabilization of landslide prone areas. Slope stabilization along national and Dzongkhag highways.	tunneling to bypass landslide prone areas				6,038,647 (Slope Stabilization)

5. HEALTH

Climate impacts on human health are starting to manifest in terms of increasing risks of vector- and water-borne diseases, and direct impacts on lives from climate induced disasters. Other emerging threats that have come to the fore in the light of the COVID-19 pandemic include risk of zoonosis events because of changing wildlife habitats and increasing intersection between wildlife, livestock, and human settlements. In addition to implementing measures to address the various emerging risks on human health from climate change, the adaptation needs in the health sector include enhancing capacity and building resilience of the health infrastructure against climate risks and impacts so that such services can continue during extreme events.

Measures for the health sector include, building resilience of critical public health infrastructure against extreme events and long-term climate risks. Enhancing health emergency preparedness to respond to climate induced disaster and enhancing surveillance and management of climate sensitive and vector borne diseases is needed. To support the monitoring and health services for, further research and capacity building of the health sector is needed, since the topic of climate risk integration is a fairly new topic among health professionals and practitioners in Bhutan. The health sector also depends on cross sectoral collaboration and coordination, since the determinants of health fall on other sectors and agencies, such as through WASH facilities, design of the living environment and disaster risk reduction and management. In the health sector, stakeholders have identified the participation of senior citizens and retired professionals as partners to fill in gaps in specialised capacity and provide support in outreach and advocacy to vulnerable groups.

	Strategic Objectives	Strategic Outcome	Strategic Action	Short Term activities (0-5yrs)	Medium term activities (5-15yrs)	Key Performance Indicator (KPI)	Lead agency	Collaborating partner	Est costs (USD)
1	Build resilience of critical public health system and infrastructure against extreme events and long-term climate risks	Improved resilience of health system to climate change	Improve health infrastructure and equipment to adapt to climate change impacts	Strengthen laboratory facilities and monitoring systems for climate sensitive diseases.	-	Monitoring system for climate sensitive diseases established New laboratory technologies introduced to detect emerging/re-emerging diseases induced by climate change	MoH	RCDC Relevant CSOs including RSSC	1,811,594
			Improve access to water supply and sanitation	Improve existing WASH Infrastructures with climate change	Build new WASH Infrastructures with climate change resilient	Number of health facilities with climate	MoH	HIDD,	603,865

	Strategic Objectives	Strategic Outcome	Strategic Action	Short Term activities (0-5yrs)	Medium term activities (5-15yrs)	Key Performance Indicator (KPI)	Lead agency	Collaborating partner	Est costs (USD)
			for health facilities	resilient technology and inclusive accessibility based on the WASH FIT tool assessment	technology and inclusive accessibility based on the WASH FIT tool assessment	resilient WASH facilities and inclusive accessibility		Relevant CSOs including RSSC	
				Strengthen the monitoring mechanism for WASH improvements in HCFs through close collaboration among RCDC, IPC, QASD and AMR	Sustain/improve monitoring of WASH facilities in HCF	Monitoring mechanism for WASH facilities established (Yes or No)	MoH	RCDC	60,387
				Strengthen waste management system in healthcare facilities and Thromdes to control climate sensitive disease vectors	Continue to improve on waste management at all levels in health facilities and Thromdes to control climate sensitive disease vectors	Number of health facilities with standard and functional waste management infrastructure	MoH	Thromde / Municipalities Relevant CSOs including RSSC	458,937
2	Enhancing health emergency preparedness & response to climate induced disasters	Improved capacity of health facilities to handle climate change	Enhance Emergency Preparedness and Response Capacity	Conduct vulnerability assessment of health care facilities for climate change induced disasters	Reduce impact of climate change on health care infrastructure.	Number of health care facilities assessed for vulnerability to climate change induced disasters.	MoH	DoLGDM Relevant CSOs including RSSC,	60,387
						Number of health care infrastructures adapted to climate change induced disasters.			3,623,188

	Strategic Objectives	Strategic Outcome	Strategic Action	Short Term activities (0-5yrs)	Medium term activities (5-15yrs)	Key Performance Indicator (KPI)	Lead agency	Collaborating partner	Est costs (USD)
		induced disasters		Capacity development on climate induced emergency medical services	Continue Capacity development on climate induced emergency medical services	Turnaround time improved	MoH	DoLGDM	4,227,053
3	Enhancing surveillance and management of climate sensitive and vector borne diseases	Reduced risk from climate sensitive and vector diseases (malaria, dengue, kala-azar etc) on vulnerable populations particularly in warm regions.	Enhance and integrate the existing early warning system for climate sensitive diseases through a surveillance system and prediction model.	Strengthen existing surveillance system.		Integrated climate sensitive diseases surveillance system functional.	MoH	VDCP & RCDC	30,193
				-	Develop a vector borne diseases early warning and prediction model	Vector borne disease early warning and prediction model developed.	MoH	KGUMSB, NCHM & RCDC	42,271
				Develop monitoring framework for prevention and control of climate sensitive diseases	-	Monitoring framework for diseases surveillance system developed	MoH	RCDC	42,271
			Establish International coordination and collaboration in border regions with high-risk cross-border	Cross border collaboration for climate sensitive diseases prevention and control (migrant screening, vector surveillance in project areas, awareness)	-	Joint cross border collaboration action plan in place	MoH	Respective Districts	30,193

	Strategic Objectives	Strategic Outcome	Strategic Action	Short Term activities (0-5yrs)	Medium term activities (5-15yrs)	Key Performance Indicator (KPI)	Lead agency	Collaborating partner	Est costs (USD)
			climate sensitive diseases transmission	-	Review and sustain cross border collaboration	Joint cross border collaboration action plan reviewed	MoH	Respective Districts	30,193
			Strengthen program capacity for management of climate sensitive and vector borne diseases	Enhance capacity of health workers for management and surveillance of climate sensitive and vector borne diseases	-	Number of health workers trained for management of climate sensitive, and vector borne diseases.	MoH	KGUMSB	90,580
				Establish national center for training and research on VBDs and zoonoses	-	National center for training and research on VBDs and zoonoses established	MoH	RCDC & KGUMSB	5,434,783
				-	Develop HR capacity for National centre on training and research for climate sensitive diseases		MoH	KGUMSB,	90,580
				-	Operational research on VBDs		MoH	KGUMSB	30,193
			Strengthen community resilience to VBDs	Develop community capacity for prevention of VBDs in high-risk areas	-	Number of people from community trained on prevention of VBDs	MoH	Respective Districts & Local Govt	45,290
				-	Review of community participation to develop	Review report	MoH	Respective Districts & Local Govt	45,290

	Strategic Objectives	Strategic Outcome	Strategic Action	Short Term activities (0-5yrs)	Medium term activities (5-15yrs)	Key Performance Indicator (KPI)	Lead agency	Collaborating partner	Est costs (USD)
					sustainable community engagement plan				
			Strengthen capacity of health centres for water quality and monitoring to international standards.	Capacity development of pre-service and in-service health workers on water quality monitoring as per international standard	Certification of health center	Number of Health Centres with certified health workers	MoH	RCDC	120,773
4	Building awareness and capacity of the health sector on climate change adaptation	The health sector is sensitised and able to start integrating climate change adaptation in overall health programs and plans	To enhance capacity of health sector to address risks and impacts of climate change on health	Enhance capacity for diagnosis and management of new/emerging climate sensitive diseases)	Continue capacity development for diagnosis and management of new/emerging climate sensitive diseases)	Number of health workers trained	MoH	KGUMSB BSF, CSO health and sanitation thematic group, Relevant CSOs including RSSC	36,232
				Training of health workers on climate change adaptation using WHO training modules	Continue same training	No of health workers trained on health and climate change	MoH	KGUMSB BSF, CSO health and sanitation thematic group,	301,932
				Create awareness to workers and employers of the potential accident and disease risks	-	Number of awareness campaigns conducted	MoH	KGUMSB Relevant CSOs including RSSC	48,309

	Strategic Objectives	Strategic Outcome	Strategic Action	Short Term activities (0-5yrs)	Medium term activities (5-15yrs)	Key Performance Indicator (KPI)	Lead agency	Collaborating partner	Est costs (USD)
				associated with climate variabilities					
			Integrate and organised climate change teaching and learning curriculums	CC integrated into existing curriculums. Capacity to handle climate sensitive health issues	Review and update pre-service and in-service curriculums. Enhance parasitology & entomology pre-services training in the KGUMSB Initiate long term training such as Masters' and Ph.D. programs for CC and related health issues	Climate integrated curriculum available. Number of faculties trained	KGUMSB	MoH, NEC and BMHC Relevant CSOs	36,2319
			Improve risk communication on rising trend of emerging and re-emerging infectious diseases on zoonoses (eg. Influenza and COVID-19)	Strengthen disease outbreak investigation and response for prioritized zoonoses issues.	Sustaining activities for the readiness to combat hazard and contain infectious diseases (Emerging and re-emerging infectious diseases).	Number of stakeholders sensitized in districts on One Health approach. Established functional National One Health Technical Committee and conduct meeting biannually. Times disease outbreak investigation and containment measures responded.	MoH	One Health Secretariat and National One Health Technical Committee (Ministry of Health and Ministry of Agriculture and Forests) Relevant CSOs	603,865
				Conduct awareness campaigns on risks of increased zoonoses events from human wildlife interface and		Advocacy conducted with relevant stakeholders in the districts. Evaluating knowledge, attitude and	MoH		603,865

	Strategic Objectives	Strategic Outcome	Strategic Action	Short Term activities (0-5yrs)	Medium term activities (5-15yrs)	Key Performance Indicator (KPI)	Lead agency	Collaborating partner	Est costs (USD)
				livestock due to climate change.		practice on health and hygiene.			
5	Research on impacts of climate change on human health	Generated evidence on health impact of climate change for enhanced adaptation to climate change	Generate scientific evidence on health and climate change through targeted research on the impacts of climate change on health and health system in Bhutan	Conduct climate change related emerging disease burden study in the country	Develop climate Sensitive Diseases (CSD) early warning and prediction model	Information on burden and epidemiology emerging Climate Sensitive Diseases(CSD) available for effective implementation of control and interventions Facility based CSD prediction model in place	MoH	KGUMSB, RCDC, NCHM and Hospitals Relevant CSOs	241,546
				Assess health system vulnerability and adaptation to climate change	Build institutional capacity to adapt to climate change	Study report. Number of health centres with CC initiative introduced	MoH	KGUMSB, Hospitals	483,092
				Policy review on integration of health in policies of health determining sectors	High level advocacy for integration of health in the policy of health determining sectors	No of policy review conducted on health climate change	MoH	KGUMSB, NEC, MoAL, RSTA, MoIT and Thromdes, Relevant CSOs	30,193
				Assess risk of heat waves and heat stress across different population groups	Develop early warning systems for heat waves and stress	Assessment report for impact of heat waves on human health	MoH	KGUMSG and MoLHR Relevant CSOs including RSSC	72,464

6. ENERGY

Hydropower is the source of almost 100% of electricity generation in Bhutan and is another factor enabling Bhutan to remain a carbon neutral country. Hydropower development has been a major driver of economic growth and the sales and export of hydropower is a significant source of national revenue. While generation of hydroelectricity is much lower in winter climate change is expected to worsen the situation with projections of drier winters. Increasing intensity of monsoons, increased sedimentation can also increase maintenance costs of hydropower plants, while the risk of glacial lake outburst floods (GLOF) threatens such large investments.

Adaptation measures in energy sector therefore in a two-pronged strategy on climate proofing hydropower investments and diversifying energy sources beyond major hydropower project by developing and scaling up alternative renewable energy programs. These adaptation measures have mitigation co-benefits, but adaptation in the sector is equally important to ensure energy security. The priority measures for hydropower are based on the priorities identified in the technical assessment for water sector as part of the NAP readiness project, 2nd NDC, Third National Communication and the Sustainable Development Hydropower Policy.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est cost (USD)
1	Diversification of energy systems to reduce vulnerability of hydropower from climate change	Increased resilience of energy system and energy security and reduced GHG emissions	Pursue Alternative renewable energy program (AREP) consisting of solar, wind, green hydrogen, and waste-to-energy technologies	Assessment and development of green hydrogen roadmap	Implementation from the recommendation of green hydrogen roadmap	Hydrogen roadmap developed and recommendations of green hydrogen roadmap implemented	DoE, MoICE	DGPC, BPC, MoF, MoIT, Local Govs, Thromdes, Pvt sector, relevant CSOs	6 million (MT)
				Undertake Alternative renewable energy projects: - Rooftop Solar PV in rural areas - Renewable Energy for Climate Resilience (Phase-I) Promoting Energy Security and Transition Project	Implement rooftop solar PV at consumer's premises and development of prosumer market. Renewable Energy for Climate Resilience (Phase-II)	900kW solar prosumers installed in 300 rural households. 17.38MW Utility scale solar power plant commissioned 50MW Rooftop solar resources and its business potential developed. 50MW Roof Top solar installed across the country.			3 million (ST secured) 18.26million (ST secured) 60 Million (MT) 382 Million (MT)

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est cost (USD)
						300MW utility scale solar and 23 MW wind power plant commissioned. 656 kW & 50kW Decentralized Distributed Generation (DDG) solar PV plant at Lunana and Singye Dzong respectively			8 million (ST)
				Decentralised RE Systems	Implement waste to energy plant. Install Solar Water Heating System	10 TPD system (Thimphu & Phuentsholing Thromde) implemented. 100,000 LPD installed			1 million (MT) 1 million (MT)
			2.Implement and scale up of energy efficiency programs in the energy intensive sectors	Development of Energy Information System		EIS developed	DoE, BSB,	MoIT, NHDCL, Thromdes, Private Sector, MoAL,	0.5 million (ST)
				Implementation of Standards and Labeling scheme Development of energy efficiency codes of practice for Building Implementation of energy efficiency codes of practice for industries	Development of Minimum Energy Performance Standards (MEPs)	Standards and Labeling scheme implemented. Energy Efficiency Codes of practice for buildings developed. Energy Efficiency Codes of practice for Industries implemented			0.5 million 1 million (ST) 0.2 Million (ST)
				Certification of energy professional as energy auditors	Certification of Energy Efficiency buildings Strengthening of Electrical testing laboratory	Certified energy auditors No. of Buildings certified. Testing laboratory for lights strengthened		DOI DRC, OCP, ABI, BCCI	0.1 Million 0.2 million (MT) 1 million (ST)

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est cost (USD)
				Study on investment opportunities for energy efficiency projects		Report prepared			0.2 million
			3. Assess and incorporate climate resilient energy technologies and power system infrastructure	Assess and Incorporate climate resilient energy technologies and power systems infrastructures.	Undertake research and development of emerging energy technologies.	Project readiness report completed.	DoE		12 million
2	Increased resilience of hydropower infrastructures/ technologies to climate change.	Resilient infrastructure with limited exposure and reduced vulnerability.	Review designs and increase capacity of of hydropower projects to improve resilience	Undertake Feasibility Study of a Pumped Storage scheme and DPR update of reservoir type hydropower project	Development of a Pumped Storage Power Plant (PSPP) and reservoir type hydropower projects	1 PSPP and 1 Reservoir Hydropower Projects developed	DoE; Project SPV	DGPC, BPC, BPSO	8 million (ST) PSPP: 1,986 million (MT) Res. HPP: 1,995 million (MT)
				Investment planning and financing for 404 MW Nyera Amari-I&II Integrated Hydropower Project;	i) Construction of Nyera Amari-I&II Integrated HPP;	1 Integrated HPP and			Integrated HPP: 377 million (MT)
				ii) Feasibility study of Begana Integrated Multipurpose Small Hydropower Projects (IMSHP) for power generation & supply of drinking & irrigation water	ii) Construction of Begana IMSHP	1 IMSHP developed.			IMSHP- 30 million (MT)

7. Climate Services and Disaster Risk Reduction

Priorities under climate services and disaster risk reduction is considered a cross cutting issue that affects all sectors. The challenging mountainous environment of Bhutan with tremendous variation in topography creates challenges for providing weather and climate forecast and early warning services. Greater enhancement of climate studies including hydrological studies, improvements in climate projections and better early warning systems is a critical need. Climate induced disasters will also affect all sectors of the economy, society and particularly the vulnerable groups. While floods, landslides and forest fires are familiar climate induced disasters in Bhutan that are increasing in intensity and frequency, the increasingly erratic nature of monsoon onset and retreat threatens farmers and food security.

Therefore, the key stakeholders in leading these interventions range from NCHM, Department of Agriculture and Department of Disaster Management, in collaboration with all relevant stakeholders. The adaptation priorities for climate services and disaster risk reduction, focus on improving hydrological services for water resources management, strengthening of agro-met services and climate information system, and improvements for efficient flood forecasting and preparedness. Interventions to protect critical infrastructure and settlements also requires improved flood forecasting and preparedness and response systems, along with enhanced early warning, response, and recovery capacity.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est cost (USD)
1	Improve hydrological services for water resources management.	Adaptive capacity enhanced through robust water resources planning.	Real-time monitoring and forecasting of the flows. Climate smart water management system.	Comprehensive water resource assessment, with geo-tagging and monitoring plan. Expand and improve hydro-meteorological stations to include tributaries. Efficient database and information dissemination system on hydrometeorology.	State-of-art River monitoring and forecasting with decision support systems.	Comprehensive water resources assessment and monitoring plan produced. Number of new and improved hydro meteorological stations established. Number of forecasting products	NCHM	NEC, MoAL, MoIT, MoHA, LGs RUB	Not estimated

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est cost (USD)
				Enhance seasonal and annual weather forecasts to generate hydrological flow forecasts. Enhance hydrological Modelling and simulation for water resource forecasting		with decision support systems.			
2	Strengthen agro-met services and climate information system.	Enhanced adaptive capacity of farmers	Provide climate related agro advisories services.	Operationalise the generation of agromet advisory services. Establish end-to-end channels of dissemination of weather and climate advisories *(media, SMS, community network etc.)*	Improve accuracy	No of agro advisories disseminated on time (10 products)	DoA	NCHM, LG	10,00,000
				Develop a grassroots advocacy program on early warning preparedness for farmers and communities on extreme events and seasonal risks		No of sensitization conducted (50 sensitizations programs conducted)	DoA & NCHM	Relevant CSOs	300,000
			Innovation/ research on agromet using real time climate data.	Research on changes in crop phenology Crop suitability studies	Continue research	No of research done using real time climate data (5 nos.)	DoA	NCHM, LG	

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est cost (USD)
3	Protect critical infrastructures and settlements.	Safe, liveable, and resilient infrastructure in critical areas for flood/landslide protection	Improved/efficient flood forecasting, preparedness, and response system.	Modelling and forecasting of extreme weather events and dissemination of information to the LGs and other sectors installation of additional early warning systems at critical areas Map and target flood prone areas with specific, action-oriented communication before, during and after the flood events.	Enhance flood forecasting, and hazard and risk mapping.	Number of Flood forecasting products and services. Number of events-based maps produced.	NCHM & MoHA	LGs, MoAL, MoIT	Not estimated
4	Enhanced early warning, and response & recovery capacity	Reduced vulnerability to disasters.	Monitoring of PDGL, glaciers, snow.	Expand and improve existing early warning systems for GLOFs and other hazards	Glaciers and snow (hydrological) modelling and forecasting. Strengthen assessment studies to monitor snow and glaciers.	Number of upgraded early warning systems in place. Number of publications on GLOFs and EWS.	NCHM	LGs	Not estimated
			Comprehensive Disaster Management & Contingency Plans (DM & CP) produced and implemented	Review and update DM and CP.	Implement programs and activities under the DM and CP	Number of DM and CP reviewed and implemented.	MoHA	LGs, NCHM, MoICE, MoAL First, responders, Relevant CSOs (Red Cross)	

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est cost (USD)
			Preparedness for disaster response. Enhance awareness of communities on water related hazards (GLOF, Floods)	Ensure relief funds (and other mechanisms e.g., insurance) for fast repair and recovery of properties and infrastructures and to compensate for damages are in place. Conduct flood simulation exercises to improve the preparedness level of the community (Enabling action) Conduct awareness program on water related hazards at the community level (Enabling action) Incorporate build back better (replacement with climate resilient infrastructures) Ensure operation and maintenance of infrastructure (aimed at fast recovery).	Assessing the community preparedness towards flood and water related disasters.	Number of awareness of water related disaster conducted and knowledge transferred. Listing of communities with their preparedness towards flood and water related disasters. Number of flood related simulation exercises conducted	MoHA MoF Financial institutes	LGs, NCHM, MoAL, MoIT First, responders, Relevant CSOs (Red Cross)	

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (0-5 years)	Medium term activities (5-15 years)	Key performance Indicator (KPI)	Lead Agency	Collaborating Partner	Est cost (USD)
			Flood forecasting and monitoring improved. Build preparedness through adoption of early warning systems, forecast models, and data management.	Ensure timely and effective early warnings issued to the downstream communities. Develop Contingency plans and install Early Warning Systems with real time monitoring.	Ensure timely and effective early warnings issued to the downstream communities.	Number of early warning system with real time monitoring instituted Number of contingency plans prepared and implemented	MoICE/ NCHM	LGs	

DETAILED ENABLING ACTIVITIES

A. POLICY & INSTITUTIONAL

To ensure NAP process for the long term, some of the key enabling activities is strengthening the policy and institutional environment. Key priorities included enhancing institutional capacity to facilitate the integration of adaptation planning and implementation at all levels from national to local government institutions. A review of all relevant policies and legislation is also identified to ensure coherent climate action. Enhancing and building on ongoing efforts to ensure collaboration and coordination of adaptation among they many stakeholders across sectors and different levels is also a priority to minimise overlaps, duplications, and avoidance of maladaptation. Civil society and the private sector are identified as partners for adaptation and the enhancement of their engagement and capacity is a priority to support the NAP process.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collab agency	Est cost (USD)
1	Enhance institutional capacity to address national adaptation needs	Adaptive capacity enhanced through mainstreaming of adaptation	Facilitate establishment of CC units at all relevant agencies (core group led by a coordinator within each relevant agency) *(* Recommendation from (i) NAP Stock Taking Plan and NAP consultations) & (ii) Consultations for CBIT project)*	Develop TOR and mandates and identify climate change units in line with CC policy and NEPA 2007 Institute CC units in national agencies	Regular functioning and support for E/CC units.	1 climate unit instituted at the relevant agencies.	NEC	RCSC, Agencies	25,000
			Enhance Environment Units at Dzongkhag level.	Develop TOR and mandates for climate change units in line with CC policy and NEPA 2007 and LG Act, and of	Regular functioning and support for E/CC units.				50,000

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collab agency	Est cost (USD)
			to take on climate change issues	Gender, Environment, Climate, Disaster, Poverty (GECDP)					
2	Strengthen national policies and legislation to enhance climate change action	Enhanced implementation and enforcement of climate change resilience actions	Review and revise policies and legislation for gaps and opportunities in effective integration and implementation of climate action.	Review all relevant policies and legislation for integration of climate change action in line with CC Policy for effective integration and implementation of NAPs, NDCs and other sectoral strategies	Revise and update policies and legislation as appropriate to enhance integration of climate change action including adaptation.	Assessment report of policies and legislation # of policies and legislation harmonised and updated.	NEC	OAG, Legislative bodies, agencies, CSOs	100,000
3	Enhance coordination of climate change adaptation	Coherent and coordinated national adaptation planning and implementation	Enhance capacity of key institutions and drivers for coordination of climate change action in Bhutan	Strengthen the NEC Secretariat (CCD/DECC) in supporting the NCCC (HR, training, resources) Regular briefings to NCCC on CC Adaptation and NAP process as necessary. Annual review on NAP process by NCCC (based on C4 reports)	Continuous briefing and training on continuous basis for changing membership.	Annual reports of NCCC/NEC containing actions on climate change adaptation	NEC	NCCC & C4 member agencies	10,000
				Capacity building of Climate change Coordination Committee (C4) for its mandate on adaptation	Continuous awareness, briefing and training on continuous basis	Minutes/ reports of the C4 submitted to NCCC/NEC	NEC		50,000

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collab agency	Est cost (USD)
				(Capacity building of members of C4) Review progress in NAP process covered in meetings of the NCCC	for changing membership. Review progress in NAP process covered in meetings of the NCCC				
				Enhance One Health Initiative of MOH to include other sectors for climate change priorities in NAP	Continued engagement		MoH	MoAL & others	10,000
			Ensure continued support and improvement in knowledge management and collaboration for NAP process through the Bhutan Climate Platform (BCP).	Continuous enhancement and maintenance of Bhutan Climate Platform to support NAP process. Trainings for new collaborators and refresher for focal persons	Review and enhancements as needed. Refresher training and updates for collaborators of BCP		NEC	BCP Partners	300,000
4	Ensuring active and meaningful and inclusive engagement & collaboration of CSOs and private sector in	Holistic and inclusive adaptation planning and implementation in Bhutan	Regular engagement with CSOs and the private sector on NAP process and adaptation implementation	Annual dialogue on climate change adaptation between policy makers, academia, private sector, and civil society Engagement of CSOs and private sector in NAP implementation as per	Continuous M&E awareness. Review & update stakeholder engagement plan in NAP process.	Indicators implemented, and reports submitted	CSOA BCSN	CSO Thematic Groups	100,000

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collab agency	Est cost (USD)
	implementation of the NAP			respective roles identified in adaptation priorities and implementation strategy. Review and adapt Stakeholder Engagement Plan (SEP)[16] including broader participation from academia, civil society, and private sector					

[16] Stakeholder Engagement Plan for NAP, NAP Readiness Project, NEC/UNDP, 1 April 2020

B. M&E OF NAP PROCESS

As discussed in Chapter 5 on M&E a robust M&E system is identified as a key requirement to ensure that adaptation plans and priorities are implemented at all levels and by all key stakeholders and that intended objectives are being met. The M&E system for the NAP process in Bhutan covers three levels of processes (i) monitoring progress in the implementation of this NAP document (ii) establishing a national system to measurements of resilience and vulnerability at a higher level (iii) developing and building a national M&E system that not only supports national requirements in line with the Climate Change policy, but also supports international reporting requirements under the Enhanced Transparency Framework of the Paris Agreement.

All the proposed M&E systems are intended to build on any existing national M&E and reporting systems and other sector level M&E frameworks such as the Bhutan Water Security Index. The M&E process also includes the processes for taking stock of the iterative NAP cycle and processes for preparation of the 2nd NAP for Bhutan.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collab agency	Est cost (USD)
1	Establish and integrate a monitoring and evaluation system for adaptation in line with CC policy	Bhutan's resilience to climate change enhanced through an effective and efficient NAP process	Track and monitor the progress in implementation of the first NAP (this document)	Prepare annual progress report on implementation of the NAP. Capture best practices and lessons learned (BOPLL) in implementation of the NAP. Prepare 2nd NAP in an iterative manner	NAP Process reviewed and enhanced including preparation and implementation of subsequent NAPs in an iterative manner.	Climate change M&E system functional and providing relevant outputs for national and international reporting on adaptation (BTR, Nat Com etc.)	NEC, C4	All NAP stakeholders	$300,000
			Establish a national monitoring system to assess progress in adaptation including measurements of resilience and vulnerability to climate change in	Review and enhance the approach in *"Climate Change vulnerability analyses and mapping for NAP formulation process in Bhutan"* for measuring vulnerability & adaptive capacity at a national level and across sub-national	National system to monitor progress in adaptation implementation & tracking of adaptive capacity	A national system in place to assess progress in adaptation including measurement of	NEC, C4	All NAP stakeholders	$300,000

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collab agency	Est cost (USD)
			line with the CC policy 2020	levels of dzongkhags and gewogs. Develop a tool for assessing adaptive capacity and vulnerability to climate change to assist planners and practitioners for planning and implementation of adaptation projects and programs.	and resilience made operational.	resilience and to climate change. A tool to assist planners and practitioners in place to assess effectiveness of adaptation projects and programs in building adaptive capacity and reducing vulnerability			
				Capacity building for M&E		Protocols for M&E process, training reports.	NEC Secretariat (DECC), MoF	RUB	
			Develop and implement a NAP M&E system, that is responsive to reporting requirements of the CC policy and the Enhanced Transparency	Establish a national monitoring and tracking system to report on *"support received"* for climate change actions (mitigation and adaptation) for the Biennial Transparency Reports (BTR) by assessing and	Implement and iteratively improve M&E system.	A national reporting system for tracking adaptation support adopted and functional	NEC Secretariat (DECC), MoF	Agencies National and internatio nal, and relevant CSOs	$100,000

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collab agency	Est cost (USD)
			Framework under UNFCCC & Paris Agreement	building on existing national monitoring systems. Assess and prepare a report on the Progress, Effectiveness and Gaps (PEG)[17] on NAP process by year 3 of NAP implementation program.					
			Develop sector level M&E frameworks for critical sectors	Set up an M&E framework for the water sector along the lines of the Bhutan Water Security Index (BWSI).	Implement the M&E framework along with BWSI.	Timely reporting of BWSI on an annual basis. Annual report on BWSI published	MoENR,	Agencies National and internatio nal	$100,000

[17] The PEG Tool of LDC Expert Group of the UNFCCC is designed to assess effectiveness of NAP process by reviewing ten essential functions of the NAP process.

C. RESEARCH & DATA

Informed decision making and planning for adaptation with the best available science has been strongly recommended for the NAP process from the LEG guidelines from the NAP and through the consultations. In this regard, the research and data will be developed by implementing the "Roadmap and Strategy for Strengthening Climate Change Research in Bhutan, 2020". The priorities cover three main areas of interventions (i) Conducting specific needs-based research for the different sectors and stakeholders. (ii) dissemination of the results and information through the Bhutan Climate Portal and through education and outreach programs (ii) strengthening research for climate change adaptation in Bhutan through institutional strengthening and enhancing the Bhutan Science Foundation.

Also see Appendix I for further details on the prioritised research topics identified as need-based research for climate change adaptation through "Strategic Imperative I: Tackle issues which matter" under the "Roadmap and Strategy for Strengthening Climate Change Research in Bhutan, 2020".

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collab agency	Est cost (USD)
1	Enhance climate change action through informed planning and implementation by implementing the Roadmap and Strategy for Strengthening Climate Change Research in Bhutan (2020)	Adaptation planning and implementation in Bhutan is enhanced by the best available science in a coherent and sustainable manner	Conduct policy-relevant and need-based research for climate change adaptation through "*Strategic Imperative I: Tackle issues which matter*"	Assess the risks and impacts of climate change on food production systems. Conduct targeted research for forest fire risk management. Conduct research and document changes in biodiversity including on species and habitats, and other drivers of degradation and loss. Research on climate induced issues such as HWC and drivers of forest and biodiversity loss Research and document type of pests and diseases affecting wildlife and plants.	Review Climate Research Roadmap and prioritise next set of research to inform NAP process	Number of publications on priority research available through the Bhutan Climate Platform.	All research institutions, Line Agencies, CSOs		$5m

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collab agency	Est cost (USD)
				Conduct studies water including on trends and impacts, management, technologies, and water related disasters. Research and assessments to support diversification of energy sources considering vulnerability of hydropower. Research on economic impacts of climate change, critical infrastructure & human settlements, private sector Assessment on ecosystem/nature-based approaches for adaptation Assess opportunities for cross cutting issues and gender integration. Research and economic assessments to support diversification and resilience of private sector					
			Disseminate and increase awareness of climate change research to inform adaptation	Integrate a "Climate Research, Information, and Service Portal" (CRISP) *(Strategic Imperative III)* into the Bhutan Climate Portal (BCP)		Functional Climate Service Portal with relevant research products	NEC Secretariat	RUB, Other research institutions	$300,000

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collab agency	Est cost (USD)
			planning in Bhutan and further through strategic imperatives III and IV of the Roadmap	Mainstream and strengthen pedagogy, outreach, and capacity building *(Strategic Imperative IV) (Linked to Enabling activity E)*				MoF, MoESD Line agencies, CSOs	
			Strengthen and build sustainability of climate change research to support the NAP process for through strategic imperatives II & V and update of the roadmap.	Strengthen institutions and networks, inspire leaders, and empower researchers (Strategic Imperative II) Establish the "Bhutan Science Foundation" *(Strategic Imperative V)*	Update the Climate Research Roadmap	Bhutan Science Foundation functional and supporting relevant research on climate change	RUB RUB,	NEC Line Agencies CSOs MoF,	$5m

D. Capacity Building

Continuing capacity building is required to ensure that new actors can be effective adaptation planners and implementers, while skills and capacity will need to be upgraded for others with continually emerging new findings, methodologies, and techniques for adaptation practice. While some level of targeted capacity building has been included in the sectoral and thematic adaptation priorities, overall capacity building for the NAP process is based on the "Skills Assessment for the NAP Process in Bhutan (SANP) 2020". To fill the gaps and needs identified in the SANP, the priorities include (i) integration of climate change adaptation learning into the national education and training systems (ii)developing an institutional memory for climate change adaptation by building cohorts of training of trainers and modules in relevant institutions. (ii) promoting the awareness and utilization of indigenous/ traditional knowledge systems and (iv) ensuring sustainability with a financial strategy to sustain climate change skills development.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collab agency	Est cost (USD)
	Address capacity gaps and needs for the NAP process as per the "*Skills Assessment for the NAP Process in Bhutan* (SANP)"	Effective and locally led adaptation planning and implementation by key stakeholders and sectors	Capacity Building on adaptation learning program into the national education and training systems *(Strategy 1 of SANP)*	Development of climate change learning module and curriculum Vocational Education Curriculum Development for Climate Mitigation and Adaptation Creating awareness for students and their parents to understand climate change adaptation as a career option	Update the Skill Assessment and capacity Needs	Education curriculum incorporating climate change components	NEC Secretariat, RUB, DoE, RIM, TVET institutes	Other agencies, Pvt sector, CSOs	$300,000
			Develop institutional memory for climate change adaptation *(Strategy 2 of SANP)*	Training of Trainer (TOT) programs and development of training modules at RUB and RIM		# of TOT programs conducted	NEC Secretariat, RUB, RIM		$100,000
			Promote integration of awareness and utilization of indigenous/	Strengthen linkages with government, academia, and extension capacity of NGOs and CSOs			RUB, CSOs, CBS		$600,000

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collab agency	Est cost (USD)
			traditional knowledge systems *(Strategy 3 of SANP)*	operating in natural resource management/agriculture space. Develop and implement a public sensitization program on IKS across the community level. Develop a repository of all traditional and Indigenous knowledge systems. Mainstream IKS in development projects.					
			Develop financial mechanisms to sustain climate change skills development *(Strategy 4 of SANP)*	Develop financing strategy for capacity building. Mainstream climate change capacity development in sectoral and local budgets		Climate financing and implementation strategy includes capacity building	MoF, NEC, DLG	RUB,	$300,000

E. EDUCATION & AWARENESS

As elaborated in the chapter 4 (Implementation Strategies), education and awareness for key stakeholders along with awareness about climate change and adaptation among the public is critical to ensure buy in and support for the NAP process. The strategy for this priority includes (i) integration of climate change adaptation into education curriculum (ii) enhancing the skills pool for climate change adaptation planning and research through targeted scholarships (iv) conducting advocacy campaigns on climate change adaptation, preparedness, and early warning as part of the communication strategy. Key partners in education and awareness include CSOs, the media and media production houses from the private sector.

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collab agency	Est cost (USD)
	Enhance education and awareness on climate change adaptation	Awareness and understanding of climate change risks and adaptation among the wider population for more effective collaboration and individual actions.	Integrate climate change adaptation into education curriculum	Review and integrate climate change and adaptation into education curriculum in a comprehensive and holistic manner at appropriate levels[18] d. Update information on CC for already integrated curriculum (higher levels) e. Refreshers and training for teachers f. Fill gaps in lower level by activity or other modes (clubs, activities, scouts, exploratory)	Review and update	Inclusion of climate change and adaptation in curriculum	NEC Secretariat, RUB	Relevant CSOs	*300,000*
			Enhance the skills pool for climate change adaptation planning and research through	Provide scholarships for specialised trainings for key course based on Skills Assessment Plan			MoESD, RCSC CSOs (eg Loden Foundation, Tarayana)	NEC, BTFEC RUB	*500,000*

[18] See the report *"The Heat is on! Towards a Climate Resilient Education System in Bhutan",* UNICEF, 2022

	Strategic Objective	Strategic Outcome	Strategic Action	Short term activities (1-5 yrs)	Medium term activities (5-15 yrs)	Key performance Indicator (KPI)	Lead agency	Collab agency	Est cost (USD)
			targeted scholarships					Sectors	
			Conduct advocacy campaigns on climate change adaptation, preparedness, and early warning as part of the communication strategy for NAP in Chapter 4.	Targeted training advocacy for (policy makers, planners, and practitioners) on CC adaptation planning and implementation and integration through climate training programs and training of trainer programs	Review and refresher courses	Number of advocacy programs a year	NEC Secretariat, RUB, partners	Relevant CSOs	*100,000*
				AV products for broadcast, print and online/social media developed and delivered.	Review and update	Number of media products in print and online media	NEC Secretariat, agencies, Media partners, (public broadcasters, film association, BMCD, JAB)	Relevant CSOs	300,000
				Develop and conduct grassroots advocacy program on climate risks and adaptation, particularly for vulnerable communities and groups	Review and update	Number of outreach campaigns a year	NEC Secretariat, agencies, FIs Media partners, (public broadcasters, film association, BMCD, JAB)	Relevant CSOs	*600,000*

APPENDIX I: DETAILS ON RESEARCH TOPICS FOR ENABLING ACTIVITY C. RESEARCH AND DATA

Details on research topics strategic action "Conduct policy-relevant and need-based research for climate change adaptation through "*Strategic Imperative I: Tackle issues which matter*" under Enabling Activity C. Research and Data

	Research topics (for years 1-5)	Activities and subtopics	Medium term activities (5-15 yrs)	Lead	Collaborating partners
1	Assess the risks and impacts of climate change on food production systems	Assessment of climate risk and impacts on livestock production and management system	Monitoring and research in field and update of assessments	DoL	NEC Secretariat, CRBS
		Conduct risk assessment of emerging livestock pest and diseases in relation to climate change	Monitoring and research in field and update of assessments	DoL	NEC Secretariat, NCHM, CRBS
		Assessment of climate risk and impacts on agriculture including on production systems and post-harvest management and market impacts	Monitoring and research in field and update of assessments	DoA	(NEC Secretariat, NCHM, RUB , IPCC, FAO, etc.), CRBS
		Conduct crop phenological studies in relation to climate change	Continues	DoA	(NEC Secretariat, NCHM, RUB, CRBS
		Conduct risk assessment of pests and diseases, and invasive alien species of agricultural crops, and develop a strategy for management	Implement and continue	DoA	CRBS RSSC
		R&D in soil nutrient management		DoA	(LG)
			Promote R&D in irrigation water management	DoA	(NCHM, DoFPS, LG)
2	Conduct targeted research for forest fire risk management	Conduct research on fire ecology under different ecosystems and tree species that are fast growing and more resistant to fire damages	Research on best applicable technologies for fire prediction and suppression	DoFPS	

	Research topics (for years 1-5)	Activities and subtopics	Medium term activities (5-15 yrs)	Lead	Collaborating partners
3	Conduct research and document changes in biodiversity including on species and habitats, and other drivers of degradation and loss.	Conduct research to identify the species and ecosystems that are vulnerable to CC and their distribution.	Research on impacts of CC on vulnerable species and ecosystems.	DoFPS	
4	Research on climate induced issues such as HWC and drivers of forest and biodiversity loss	Research on the impacts of CC on HWC	Research on efficacy of protected areas network (PABC) under changing climate.	DoFPS	CRBS
		Research on drivers impacting forest cover and biodiversity at different locations and intensity.	Research on whether climate change effects on impacts of drivers	DoFPS	NEC Secretariat, NBC
5	Research and document type of pests and diseases affecting wildlife and plants	Identification of pests and diseases in plants and wildlife under changing climate.	Research and adoption of best management practices for priority pest and diseases	DoFPS	RUB
6	Conduct studies water including on trends and impacts, management, technologies and water related disasters	Promote R&D in irrigation water management. Conduct studies on hydrological models to generate information to characterize and manage sub-catchment areas management. Detailed study on irrigation water shortages.	Engage academic institutions to conduct research and studies on varying issues and enhance climate-smart irrigation schemes. Conduct research on crop water requirement- can be enabling. Promote Research and Development practices for irrigation under the local context.	DoA RUB, CRBS, CNR	NCHM, LG DoL
		Systematic study of groundwater availability, use, risks, and potential.	Initiate use of groundwater or discontinue based on findings from the study.	MoENR	MoICE RUB, MoIT, MoAL
		Research on water technologies (fog/rainwater harvesting and other climate-proof technologies) to build resilience.		MoENR, RUB	

	Research topics (for years 1-5)	Activities and subtopics	Medium term activities (5-15 yrs)	Lead	Collaborating partners
		Systematic study of spring sheds *to assess and revive drying springs*.	Revival of drying springs.	MoENR, MoAL, RUB	
		Assess the flow from snow and glaciers and its contribution to springs and streams (temporal and spatial) through hydrographic separation (isotope) studies on river basins, snow cover extent and glacial mass balance.	Comprehensive information on snow and glaciers contribution to river systems Understanding the impact on the river systems considering melting glaciers	NCHM, RUB	
		Research on geomorphological study of river systems to understand the flow pattern, river characteristics and sediment load to design and propose adaptation options	Delineate and limit the area of development. Implement the proposed adaptation options	MoICE, MoIT, NCHM, RUB	
7	Research and assessments to support diversification of energy sources considering vulnerability of hydropower	Research and assessment on potential and feasibility of alternate renewable energy in Bhutan.	Feasibility assessments of prioritized technologies and projects	DRE	RUB
8	Research on economic impacts of climate change, critical infrastructure & human settlements,			MoIT	RUB
9	Research and economic assessments to support diversification and resilience of private sector	Research on economic impacts of climate change on the private sector		MoICE	BCCI

	Research topics (for years 1-5)	Activities and subtopics	Medium term activities (5-15 yrs)	Lead	Collaborating partners
		Investments in research for crop, climate, and econometric models to support research in forecasting climate variability		DoA/DoL	RUB
10	Assess opportunities for cross cutting issues and gender integration	Gender and climate change adaptation study to inform adaptation planning in additional sectors (baseline of Gender NDC Study 2020)		NCWC	NEC, RUB
11	Assessment on ecosystem/nature-based approaches for adaptation			MoENR,	RUB, DoFPS, MoIT

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