



Institute  
for GNH Studies

**iGNHaS**



## **Bhutan Himalayan Climate Studies**

### **Science Dialogue – Series II**

***Theme: Climate Change on Mountain Livelihood and Food Security***

**Organized**

**By**

**Centre for Sustainable Mountain Agriculture, College of Natural Resources,**

**and**

**Institute for Gross National Happiness Studies (iGNHaS),**

**Royal University of Bhutan, Thimphu**

**On**

**11<sup>th</sup> March, 2021**

**Venue: Multipurpose Hall, CNR**



## ***Theme: Climate Change on Mountain Livelihood and Food Security***

Mountain people in the Hindu Kush Himalayan (HKH) region are highly vulnerable to food insecurity because of their low productivity, subsistence economies, constraints of terrain and climate, poor infrastructure, limited access to markets, physical isolation, vulnerability to natural hazards and high cost of food production and transportation. The natural resource base like soil nutrients, water and biomass, are steadily depleted resulting in a significant decline in food production. Increasing impacts of climate change is adding food insecurity where people are displaced, deep traditions and cultures of locality threatened for sustainability.

Subsistence agriculture, livestock, horticulture and non-wood forest products are the main sources of livelihoods in the HKH region. Climatic changes have led unprecedented changes in precipitation patterns and hydrological imbalances, rises in temperature, frequent floods and degradation of the forests, rangelands and agricultural land.

To best prepare Bhutan for current and future challenges, the Royal University of Bhutan (RUB) is committed to playing a central role in fundamental research on climate science, impacts, adaptation and mitigation through the Bhutan Himalayan Climate Studies (BHCS) project, dedicated to building long-term capacity of climate-related expertise. RUB aims to establish as an academic hub for climate change studies, especially in the context of the HKH region, by bridging the gap between climate adaptation research, policy and operations through the BHCS project that will also coincide with Bhutan graduating from its Least Developed Country status in 2023.

In this second series of science dialogue, the theme is focused on “*Climate change on mountain livelihood and food security*”. Her Excellency the Resident Representative of UNDP Bhutan and Professor Stephen Williams from James Cook University, Australia will address to the dialogue series. The technical session speakers from Department of Agriculture, Department of Livestock, Department of Forests and Park Services, Department of Local Governance of the Royal Government of Bhutan, and College of Language and Culture Studies, and College of Natural Resources from the RUB will share their perspectives on climate change on mountain livelihood and food security.

The science dialogue is hosted by the College of Natural Resources, Royal University of Bhutan, Lobesa.

Interested participants can register through the link below till 8<sup>th</sup> March 2021 and registration will be closed by 4.00 PM (Bhutan Standard Time). A webinar link will be shared to all registered participants.

Registration: <https://rb.gy/g8qd7u>

## Programme Schedule

Master of Ceremony: Ms Ugyen Yangchen, Lecturer, College of Natural Resources, RUB

Rapporteur: Ms Tshering Choden, OVC & Dr Jigme Tenzin, CNR

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### Session I

#### Inaugural

09.30 – 9.40 AM

Arrival and reception of Guests

09.40 – 09.50 AM

MARCHANG CEREMONY

09.50 – 10.00 AM

Welcome remarks by Dr. Phub Dorji, President, College of Natural Resources, RUB

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### Session II

#### Climate change on Mountain Livelihood

**Moderator:**

Dr. Phanchung, Director, Department of Research and External Relations, RUB

10:05 – 10.20 AM:

Inaugural Keynote Address by Her Excellency Ms Azusa Kubota, Resident Representative, UNDP Bhutan

10.20 – 10.40 AM:

Understanding the role of Bhutanese cultural beliefs in a changing climate by Mr Dorji Gyeltshen and Ms Dawa Zangmo, College of Language and Cultural Studies

Q & A

10:40 – 11.00 AM:

Role of Local Government in climate change by Mr Sonam Tashi and Mr Sangay Dorji, Ministry of Home and Cultural Affairs

Q & A

11.00 – 11.30 AM

Tea Break and Photo Session

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### Session III

#### Climate change on Food Security: Forestry and Sustainability

**Moderator:**

Dr D.B Gurung, Professor, College of Natural Resources, RUB

11:30 – 11.50 AM:

Shifting species distributions under a changing climate is important to everyone by Professor Stephen Williams, James Cook University, QLD, Australia

Q & A

11:50 – 12.10 AM:

Forest and Climate Change in Bhutan by Dr Jigme Tenzin, Department of Forest and Park Service

Q & A

12:10 – 12.30 PM:

Climate change impacts and its implication to food security and sustainable development in Bhutan by Dr. Om Katel, Ms. Chogyel Wangmo, and Mr. Tashi Dorji, Associate lecturer at the College of Natural Resources, Royal University of Bhutan

Q & A

**12.30 – 13.20 PM: LUNCH BREAK**

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**Session IV Climate change on livestock, farming systems and nutrient security**

**Moderator:** Dr Ugyen Thinley, Asst. Professor, College of Natural Resources, RUB

13:30 – 13.50 PM: Sustainable climate smart livestock production systems in vogue in Bhutan by Dr Kuenga Namgay, Department of Livestock, Ministry of Agriculture and Forest

Q & A

13:50 – 14.10 PM: Climate change impact and adaptation strategies to enhance climate resilient farming system in Bhutan by Jigme Tenzin, Department of Agriculture, Ministry of Agriculture and Forest

Q & A

14:10 – 14.30 PM: Water Scarcity adaptation in agriculture for food and nutrient security by Dr. Sonam Tashi, College of Natural Resources

Q & A

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**Session V Closing and wrap-up**

14: 30 – 14.40 PM: Closing Remarks and Vote of Thanks by Dr Om Katel, Dean of Research and Industrial Linkages, CNR

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## GUEST SPEAKER



Her Excellency Ms. Azusa Kubota is the Resident Representative of UNDP in Bhutan since March 2019. Her Excellency has served earlier as the Manager and Head Office of UNDP in the Solomon Islands and the UN Joint Presence Manager for UNDP, UNICEF, UNFPA and UN WOMEN, Deputy Resident Representative (Programme and Operations) of UNDP in Laos PDR and the Maldives. Madam Azusa has been responsible in drafting guideline on programme management and evaluation for UNDP, organizing international conference and trainings, supporting interventions on trade and investment promotion, capacity building and system development in planning, monitoring and evaluation for national poverty reduction strategies and pro-poor budgeting. She has a postgraduate degree in International Affairs in Economic and Political Development.

## MODERATORS



Dr Phanchung is the Director of the Department of Research and External Relations of the Royal University of Bhutan. He has a PhD degree from the University of Melbourne, Australia. Dr Phanchung has more than three decades of public service experiences as an academic, administrator, planning and a rural development agent in various institutions in Bhutan. He is the Secretary to Research and Innovation Committee and Research Degree Committee of the University and also serve as Member to various Committees of the Royal University of Bhutan. Dr. Phanchung is also the Managing Editor of the *Bhutan Journal of Research and Development* and Board Member of the Climate Change Coordination Committee of Royal Government of Bhutan.



Dr D B Gurung is a Professor in the Department of Forest Science in CNR. He teaches Statistics, Research Methodology, and Freshwater Ecology to Master and Undergraduate programmes in CNR. Professor Gurung has published several papers in peer reviewed journals, book and book chapters, and also in the conference proceedings. Prof Gurung has offered many consultancy services and conducted trainings, workshops, and seminars. He has led several international and national projects and is passionate of his research in orchids, fishes, macroinvertebrates and herpetofauna in Bhutan.



Dr Ugyen Thinley has PhD degree from Khonkaen University Thailand. He serves as Assistant Professor in the Department of Forest Science and teaches forestry science subjects.

## TECHNICAL SPEAKERS



Ms. Dawa Zangmo graduated from Sherubtse College, Kanglung, with specialization in English and Geography. She has nine years of work experience in both Bhutan and Thailand in the fields of media and education and currently teaches Contemporary Literature at College of Language and Culture Studies, Taktse, Trongsa.



Mr. Sonam Tashi has undergraduate degree in Economics with Environmental Science and postgraduate diploma in public administration (PGDPA). Mr Sonam Tashi has experience of working with Ministry of Labour and Human Resources and Ministry of Home and Cultural Affairs. Mr Sonam Tashi was involved in implementing climate change adaptation projects/activities at the Gewog and Dzongkhag level besides monitoring and evaluation of climate change adaptation projects at the Gewog level.



Professor Stephen Williams is the inaugural Director of Centre for Tropical Biodiversity & Climate Change research (CTBCC). He has convened the National Adaptation Network for Natural Ecosystems hosted by James Cook University for the National Climate Change Adaptation Research Facility (NCCARF). Prof Stephen Chairs IUCN Climate Change & Biodiversity Specialist Group and Wet Tropics Management Authority Science Advisory Committee. His research to identify global climate change as a severe threatening process in the tropics that face many species extinctions in mountain systems around the world. His research is focused on understanding biodiversity, assessing the vulnerability of biodiversity to global climate change and using this knowledge to maximize the positive benefits of conservation management and adaptation.



Dr. Jigme Tenzin currently works as the Deputy Chief Forestry Officer in the office of Watershed Management Division, Department of Forests and Park Services. He has a PhD in Forest management from the University of the Natural Resources and Life Sciences, Vienna, Austria. He currently heads the REDD+ and Climate Change Section of the Watershed Management Division. He also serves as the National Focal Point for the REDD+ and represents the Department of Forests and Park Services at the Climate Change negotiations under the United Nation's Framework Convention on Climate Change (UNFCCC).



Dr. Om Katel is a Dean of Research and Industrial Linkages at the College of Natural Resources, Royal University of Bhutan. He teaches courses on Applied Conservation Science, Natural Resources Management, Climate Change Adaptation, Integrated Watershed Management and Geographical Information System to Undergraduate and Postgraduate students. He has network of Youth Encounter on Sustainability (YES), Intensive Program on Sustainability (IPoS), International Center for Climate Change and Development (ICCCAD), Centre for Development Innovation (CDI), Alliance for Global Sustainability (AGS), and South Asian Network for the Development and Environment Economics (SANDEE). Dr Om Katel is focal staff for the Least Developed Countries on Consortium on Climate Change (LUCCC).



Dr Kuenga Namgay is the Executive Specialist of Livestock Department under Ministry of Agriculture and Forests. He holds PhD from School of Environmental Sciences, Faculty of Science, Charles Sturt University, NSW, Australia and Masters in Animal Science and Aquaculture from Wageningen University, the Netherlands.



Mr. Jigme Tenzin is Principal Agriculture Officer under Ministry of Agriculture and Forest and has Master in Agricultural Science from the University of Queensland. Mr Jigme Tenzin is national Focal Officer for the National Citrus Programme and focal officer for climate change and Environment. Mr Jigme is one of the implementing Partner for GEF project.



Dr. Sonam Tashi works as an Assistant Professor at College of Natural Resources and did his PhD in Agricultural Science from University of Bonn, Germany. He did his both Master's and postgraduate in Agriculture from the University of Melbourne, Australia, and Bachelor of degree in Agriculture (Horticulture Major) from University of Philippines, Los Banos, Philippines.

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# Understanding the Role of Bhutanese Cultural Beliefs in a Changing Climate

Dorji Gyeltshen and Dawa Zangmo

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Bhutanese culture, tradition and beliefs are intricacies realm that intertwined tightly in the web of everyday Bhutanese life. Its inimitable values and traditional which are the indispensable epitomes of the country's identity have abetted the people to live closely with the changing climate and weather till date without much fuss. However, owing to the geographical location, Bhutan inexorably is experiencing flash floods in the southern part of the region; unprecedented heat waves across the country, erratic rainfall and water supply, commotions in agriculture practices, hitherto these are some of the confirmations that climate change is real, although evidential statistics figure is limited.

Today, climate change and global warming, dubiously has widely accepted as one of the most perilous and multifaceted trials encountering humanity. However, for the last century, local beliefs have somehow sustained Bhutanese to become more resilient and apprehend changing climate in Bhutanese context.

With the 72% of population living in rural areas that rely their livelihood on substance farming, conversely majority cannot comprehend the meaning and implication of climate change and global warming at the present time.

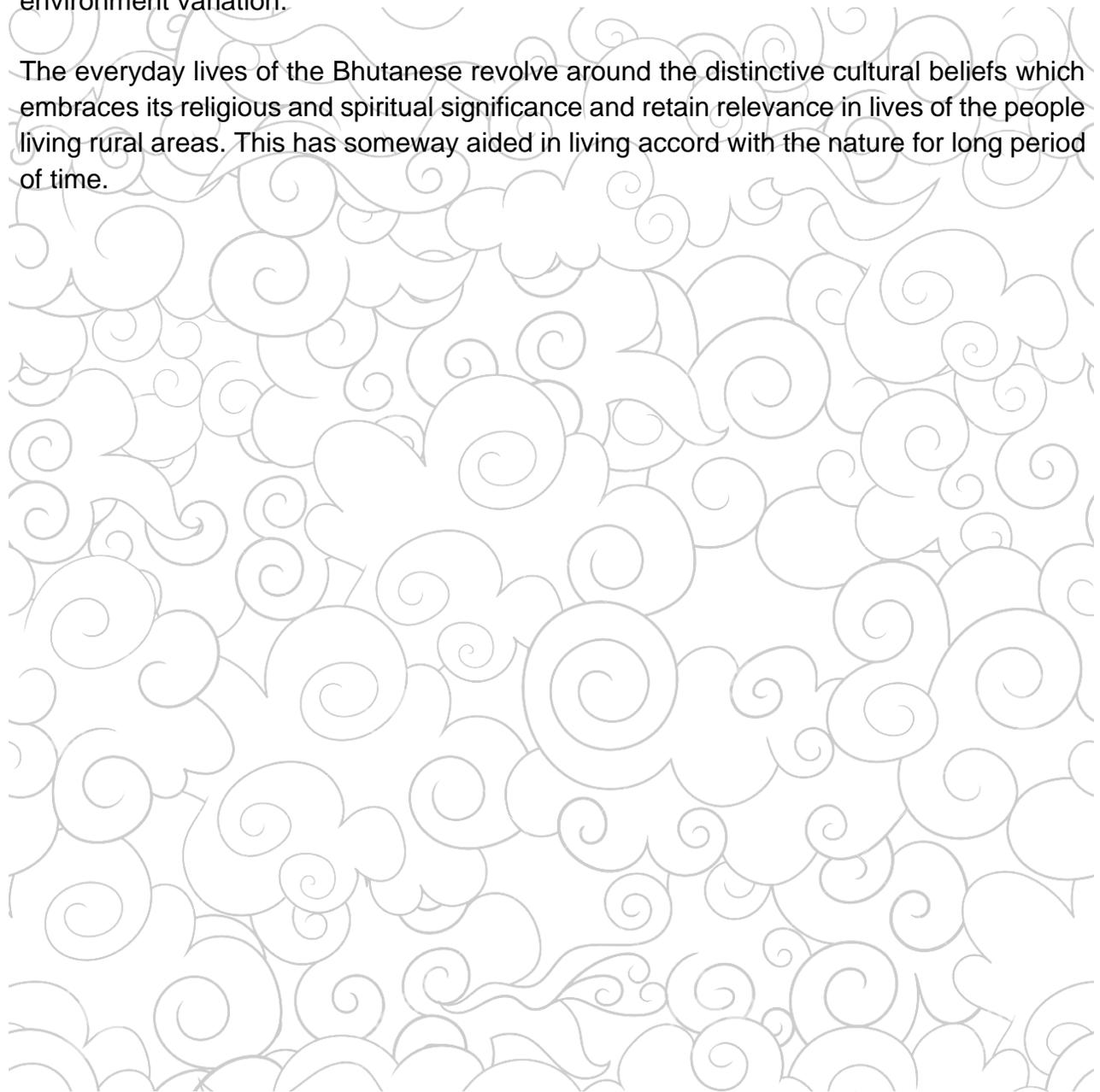
In Dzongkha language, *namshee* infers to both climate and weather change, many people understand Namshee Jurwa as both climate change as well as global warming.

So, it is not only pivotal to define a clear cut meaning and difference between these words which needs to have an equivalent terminology in Bhutanese setting but also to educate villagers about these rudimentary climate change repercussions on the agriculture especially.

According to the *Bhutan Climate Change Handbook* (2016), weather is the fluctuating state of the atmosphere around us, characterized by temperature, wind, precipitation, clouds and other weather elements. Some common examples of weather phenomena include fog, dust storm, hailstorm, and so on. Moreover, weather is the result of rapidly developing and decaying weather systems, such as low and high pressure. While on the contrary, Climate refers to the average weather and its variability over a certain time-span and a specified area.

We overhear people conversing about weather and climate all of the time. Literate people check the local weather forecast to plan their days while people in the village look up in the sky. As there is an exhilarating saying in Bhutan that the darker clouds gather on the mountaintop, the more water will rage in the river below which perceptibly portrays that how much villagers rely on their comprehension knowledge and local beliefs about environment variation.

The everyday lives of the Bhutanese revolve around the distinctive cultural beliefs which embraces its religious and spiritual significance and retain relevance in lives of the people living rural areas. This has someway aided in living accord with the nature for long period of time.



# Role of Local Government in Climate Change

Sonam Tashi and Sangay Dorji

Department of Local government, Ministry of Home and Culture Affairs,

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Strengthening local government institutions has been a key programme of the Royal Government of Bhutan since the commencement of decentralization process in 1981. In the new democratic system, the local government institutions have an increasingly important role as frontline agencies for sustainable development, facilitating direct participation of the local communities in the development and management of their own social, economic and environmental wellbeing. A robust system of local governance is also critical for the government's sustainable development policies and programmes to produce direct social, economic and environmental benefits for the local communities, especially the poor and vulnerable groups, and have a far-reaching impact.

The following factors highlight the significance of the role of Local Governments in climate change adaptation:

- v It is at the local community level that the consequences of climate change are most directly and severely felt. As formal institutions with the mandate for direct delivery of a variety of public goods and services at the grassroots level, Local Governments are best placed to help local communities adapt to the many consequences of climate change.
- v It is recognized that climate change, particularly the 'adaptation' aspect, is often a highly localized matter. Different localities may experience different climate change challenges and thus require different adaptation approaches. Furthermore, climate change problems may differ between men and women, rich and poor, old and young, and between professions and livelihoods. These local variations make climate change adaptation more suitable for local government actions.
- v Given their proximity to the local communities, Local Governments have comparative advantages in terms of access to local knowledge, ability to mobilize local communities, and deliver public goods and services to respond to climate change vulnerabilities.
- v In 2011, the RGoB piloted the Local Climate Adaptive Living Facility (LoCAL) project in two Dzongkhags and two Gewogs with the support of the United Nations Capital Development Fund (UNCDF), which has been a longstanding development partner of Bhutan. This project is directed towards building the adaptive capacity

and climate resilience of the Local Governments through climate change mainstreaming in the local development planning, budgeting, and monitoring and evaluation systems. It channels performance-based climate change adaptation grants (PBCCAGs) to Local Governments using the annual grant system, which was first introduced in 2010. The UNCDF made commitments of new funds to extend the pilot LoCAL project for two more years, i.e. fiscal years 2014/15 and 2015/16, within the overall programmatic framework of the Local Governance Sustainable Development (LGSDP). LGSDP envisaged scaling up the PBCCAGs to some 19 LGs over the period of the ongoing 11<sup>th</sup> Five Year Plan (July 2013 – June 2018). The initiative had been continued till date and it has now been rolled out to 100 LGs.

- v The overall rationale of the PBCCAG system is that it will tangibly incentivize (and therefore motivate) Local Governments to improve their performance in terms of planning and utilization of the grants for climate change adaptation. There are primarily two broad performance parameters to this grant. One concerns general public finance management and governance by the Local Governments and the other pertains to the planning and utilization of the grants to effectively respond to climate change adaptation needs at the local level.

Climate change impacts will continue to affect the country in various ways. While efforts on the part of the Government can only make small contribution to mitigating the impacts on the global stage, sustained efforts should continue to be made so that awareness is created at the local level. The collective effort at the local level is the only viable way to combat the menace of climate change.

In view of the above, the Department of Local Governance will continue to play a facilitation and policy support role so that our Local Governments are adequately informed of the adverse impact of climate change. When communities have access to knowledge, it is expected that they will change their behaviors to act responsibly and not engage in actions that could have adverse impact on climate.

However, it calls upon the Government, and for that matter the Department, that the climate change issues need to be addressed with sustained vigor, initiative and innovation. The positive actions on the part of the local communities need to be adequately rewarded. Therefore, the adaption framework should be deigned in a such a way that the Local Governments and local communities are rewarded in terms of additional financing windows and other opportunities.

“Think globally, act locally” is a fitting mental paradigm that we may need to adopt for long-term national and global interest.

## Forests and Climate Change in Bhutan

Dr. Jigme Tenzin,

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The increasing emissions of carbon dioxide and other gases, collectively known as Greenhouse gases (GHGs) from industrial development coupled with loss of forests (FAO 2010) have led to warming up of the Earth. Atmospheric temperature largely determines weather and climate patterns. So, a change in carbon dioxide levels in the atmosphere can trigger unexpected changes in the weather systems and ultimately, earth's climatic patterns. The small changes in average temperature translates to large and potentially dangerous shifts in weather and climate. The higher the temperature, the more severe the weather conditions become. This changes in the long-term weather pattern of the earth is termed as climate change.

The climate is changing and there are enough evidences collected over the years by different agencies both national and international. The average temperature has risen by almost 0.9°C over the past century and is projected to rise by 2 to 3°C over the next hundred years (Stocker et al. 2013). Ice cores drawn from Greenland, Antarctica, and tropical mountain glaciers show that the Earth's climate responds to changes in greenhouse gas levels (ICIMOD 2016). The reports on sea level rise, shrinking ice sheets & glaciers, decline in arctic sea ice, ocean acidification and decreasing snow cover, which have all increased in the last decade shows that the earth's climate is changing. The changing climate pattern comes with un-welcomed consequences to the people and the it's environment.

Bhutan emits approximately 1.5 million tonnes of carbon annually, and its forests absorb approximately 6.3 million tonnes, making it one of the few countries with negative carbon emissions. The cornerstone of this achievement is the country's sustainable forest management, strong regulatory measures, effective monitoring and addressal mechanism supported by the constitutional mandate of maintaining a minimum of 60% forest cover. Despite all these efforts, Climate change impacts are inevitable, and what Bhutan can do now is to strengthen efforts and commitment to the global goals and ambitions, mainstream climate change adaptation and resilience in forest management. These would also mean further reaffirming Bhutan's commitment like many other nations to take urgent action to combat climate change and its impacts. It is also critical for Bhutan, with a forest cover of more than 71% and an ambitious goal of staying carbon neutral, to emphasize on research and development to understand the future imminent risks to the forest's ecosystems.

# Climate Change Impacts and its Implication to Food Security and Sustainable Development in Bhutan

Om Katel, Anooja Nair, Chogyel Wangmo and Tashi Dorji  
*College of Natural Resources, Royal University of Bhutan, Lobesa, Punakha, Bhutan.*  
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When the rest of the world was bracing to embark on a growth led development model in the 1970s, Bhutan chose spirituality based developmental philosophy known as Gross National Happiness (GNH). Environmental conservation represents one of the four pillars of GNH and it is expected that conserving environment would not only help protect the environment also provide safety nets to local livelihoods for people dependent on natural resources. In terms of environmental conservation, many claim that Bhutan is not only a carbon neutral, but also a carbon sink country. The forests of Bhutan absorb over 6 million tonnes of carbon where the emission is accounted at 1.5 million tonnes.

Although environmental conservation is a positive news for environmentalists however it also bears the brunt of climate change despite any contributions to climate change. Therefore, exploring the use of alternative modes of transport such as gravity ropeways, watershed protection and management to secure water flow for the hydropower and reduce its highly vulnerable land related disasters. Improving the weather forecasting system, crop insurance to farmers and cold storage facilities for farmers could be some of the adaptation measures.

Protecting forests on the Himalayan watershed has the potential to address climate change issues through mitigation as carbon sinks and reducing the climate related hazards. Protection of forests also mean trans-boundary cooperation to reduce greenhouse gas emissions in the neighboring states of India.

Bhutan and India need to explore more options and develop strategic partnerships through academic exchange and research collaboration at the national level while at the local level Bhutan needs to invest more on the capacity building of researchers and develop research and development sectors in Bhutan.

# Sustainable climate smart livestock production systems in vogue in Bhutan

Kuenga Namgay

Department of Livestock, Ministry of Agriculture and Forests, Email: [kuengadruk@gmail.com](mailto:kuengadruk@gmail.com)

This article aims to briefly highlight the how CC might impact livestock and people's livelihood in Bhutan, and how Bhutan is contributing to CC mitigation measures through sustainable climate smart interventions in livestock production system in Bhutan.

As is common in the south Asian region, livestock forms a crucial component in the mixed farming system, contributing not only to the diet and income of farmers but also to soil fertility and draught power. Agriculture, though losing its relative importance to the country's GDP as Bhutan urbanizes, still is important for majority (62.2% of population), living in rural areas practicing subsistence to semi-commercial agriculture including livestock. The share of livestock to the national GDP has slightly fallen from 4.024% (2012) to 3.89% (2016), while the overall agriculture's share, including livestock, has significantly declined from 56% in 1980s to around 17% in 2016.

Climate change is recognized to be a major concern in the Himalayas with consequent impacts on socio-economy, culture and environment. IPCC reports also project a higher warming trend for South Asia compared to the global average. While information on climate and vulnerabilities to climate change in Bhutan is limited, the SNC and other sources indicate increasing temperatures with projection to increase further. Annual precipitation is expected to increase during monsoon season, making it wetter, while the winters will be drier. The average temperatures in Bhutan is expected to increase with possibilities for extreme hot temperature conditions.

Due to lack of technical knowhow it is difficult to assess what sort of impacts the climate change will have on livestock and livestock based livelihoods of smallholders in Bhutan. There is also lack of understanding on ways and means necessary to mitigate CC through livestock interventions. Initial assessments by some agencies indicate fragmented and poor coordination in actions related to climate change in Bhutan and recognizes the need to strengthen linkages across local level sector development plans and climate change interventions.

Today, the country is carbon negative with our forests sequestering more carbon than what it emits. Bhutan, in the first INDC in 2015, has vowed to remain carbon neutral in future. The constitution of Bhutan mandates maintaining 60% of its land cover under

forest for all times to come. Therefore, it is imperative any sectors' interventions need to consciously align with the commitments made to international community and in accordance with the country's constitution.

Livestock sector's interventions has therefore been in line with national commitment to remain carbon neutral for all times. Since the first FYP in 1960s, livestock sector has endeavored to improve livestock breeds and productions systems. These interventions were meant to achieve higher productivity with lower animal numbers, minimal environmental impacts, better enteric fermentation efficiency, improved manure management system, and an alternative energy sources to not only reduce GHG production but also lower emission into the atmosphere from fuelwood and fossil fuels.

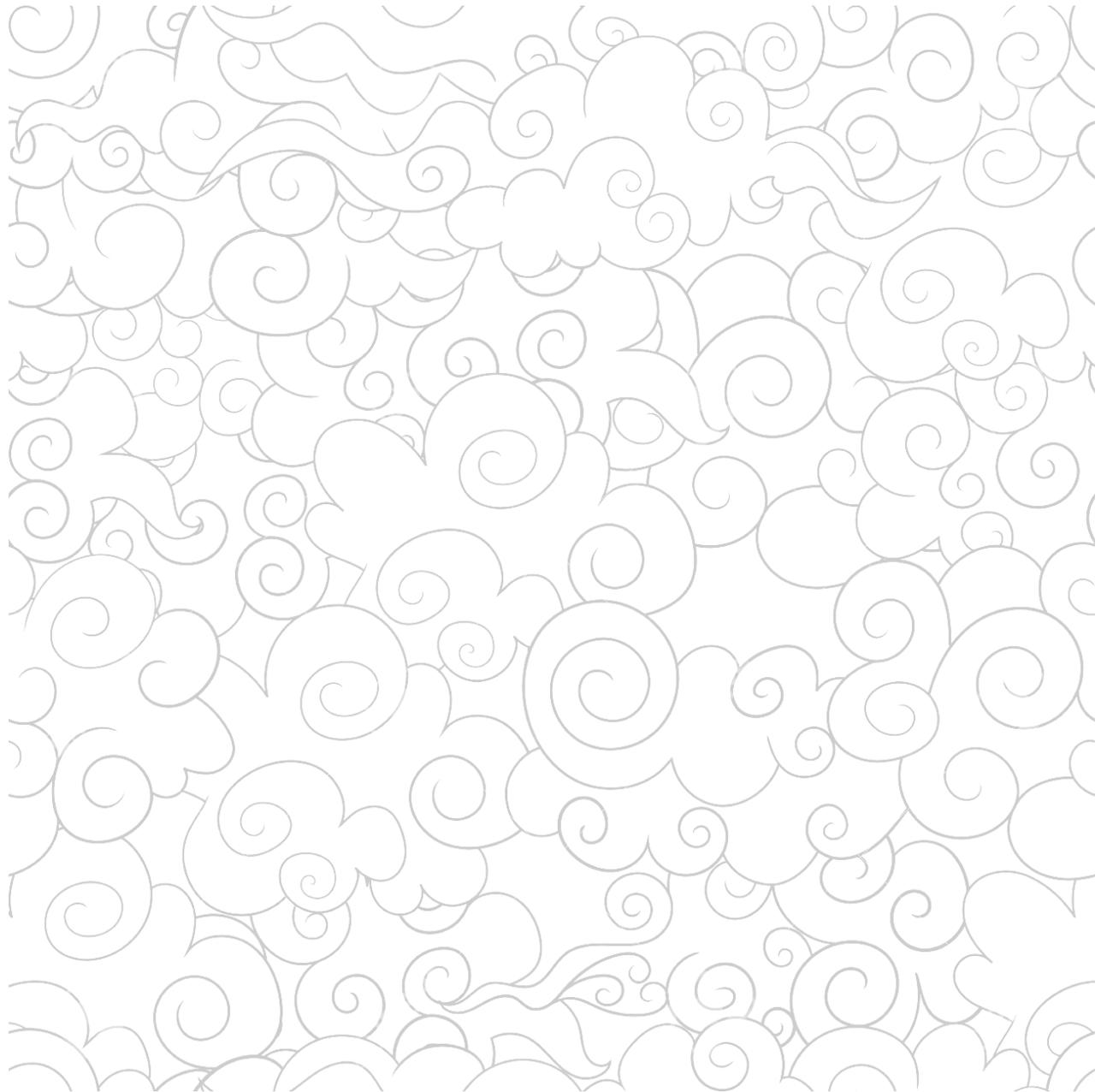
For example, 1. Pursued cross breeding of livestock with exotic breeds to increase productivity, reduce number of animals, yet maintain higher level of income, reducing overhead GHG production. 2 Improved pastures were promoted to enhance higher feed production within smaller areas. This reduces usage of areas while enhancing production and efficiency of enteric fermentation, reducing GHG production. 3. Introduced stall feeding, as opposed to traditional open grazing system, facilitating better manure management. 4. Promoted biogas production systems, utilizing the manure collected through the stall-feeding system, thus drastically reducing GHG emission into the atmosphere.

In the 12th FYP the livestock sector will develop additional 5000 acres of improved pasture, continue to encourage stall feeding, and install some 4400 new biogas plants, towards mitigation of climate change.

Biogas is a sustainable climate smart livestock intervention with multiple benefits to the environment and farmers. It helps mitigate CC by trapping CH<sub>4</sub> that can be used as an alternate energy source for cooking or heating purposes. It can replace fuelwood and fossil fuel, saving trees from being cut down and fossil fuel usage. This not only saves money for families but also improves health of women and children, as it prevents them from being exposed to smoke in the kitchen from fuelwood use. The slurry discharged from the biogas system is rich in nutrients and highly beneficial for growing vegetables.

In future it is important to build technical capacity so that an assessment of vulnerability to CC and real-time monitoring of GHG emission and control could be done. There is also a need for quantitative assessment and forecasting ability on carbon sequestration from improved pastures, biogas plants and similar climate smart interventions. Such assessments and quantifications would enable the country to produce smart reports with quantities of GHG emissions avoided towards mitigation of CC, to make realistic commitments in the international platforms. Some comparative studies of emission

differences in different farming systems would also enable accounting for carbon savings achieved through different interventions such as open grazing vs zero grazing & stall feeding. There is of course the need for resources to conduct assessments and implement climate smart and resilient interventions.



# Climate Change Impact and Adaptation Strategies to Enhance Climate Resilient Farming System in Bhutan

Jigme Tenzin

Department of Agriculture, Ministry of Agriculture and Forests , Email: [jigmetenzin@moaf.gov.bt](mailto:jigmetenzin@moaf.gov.bt)

Agriculture sector in Bhutan contributes about 17% to the National Gross Domestic Product (GDP) and provides livelihoods to 57% of its population. Agriculture production in Bhutan is highly constrained by steep terrains, limited capital resources and available technologies resulting to low productivity. Greenhouse Gas Emissions (GHGs) in Bhutan is estimated to be 1.559 megatons (Mt) Carbon Dioxide equivalent (CO<sub>2</sub>eq), while the CO<sub>2</sub> sequestration capacity is estimated at 6.3Mt, with net emissions of -4.7MT. Emission from agriculture including livestock is about 35% of the total emission. The overall increasing trend of GHG emissions in recent years inducing climate change shows significant adverse effects on the agriculture system. Glacier-melt and glacial lake outburst flood (GLOF), erratic rainfall, drying up of springs, flash floods, droughts, hails, windstorms, phenology change, and emergence of new pests and diseases are some important and emerging climate change effects experienced. Bhutan lacks institutional, infrastructure, and technical capacity in responding to changing climate and its effects. Urgent response from the government and concerned stakeholders is crucial to undertake key actions and minimize the effects of climate change on food and nutrition security. Agriculture sector has been implementing all available CSA technologies to mitigate GHG emissions and to adapt with climate change impacts. However, it is crucial for all sectors to adopt climate smart practices to reduce emissions and align plans and program with national and international commitments to achieve the climate goal. This paper briefly describes the climate change scenario, climate smart agriculture (CSA) system, policies and programs on adaptation and mitigation under agriculture sector.

# Water scarcity adaptation in agriculture for food and nutrient security

Sonam Tashi

College of Natural Resources, Royal University of Bhutan, Lobesa: Email: stashi.cnr@rub.edu.bt

Climate change is affecting rainfall pattern, hydrological cycle and global temperature (IPCC, 2014) amongst other impacts. Rainfalls are becoming untimely or too scant or too heavy and increased temperature is reducing snow cover and drying up water resources resulting in water shortages and droughts (Bhujel, 2019). Incidences of erratic rainfall and water scarcity are being increasingly reported from around the world, including Bhutan (International Centre for Tropical Agriculture [CIAT], 2017). Bhutan has recorded a gradual rise in annual mean temperature both in temperate and subtropical regions decline in mean precipitation (National Centre for Hydrology and Metrology [NCHM], 2018). Winter precipitation, which otherwise would contribute to groundwater recharge, continues to be near zero for most of the 20 districts. Water shortage and drought conditions occur generally from late November through to mid-April in most parts of the country (Quadir et al., 2007). Monsoon rain that accounts for 60-90% of the annual precipitation (CIAT, 2017) is concentrated to four months (June to September).

Water is crucial for agriculture and protracted water scarcity could constraint crop production (FAO, 2014). Agriculture uses up to 94% of the freshwater resources in Bhutan (FAO, 2011). For optimal production, most crops on an average require 300 to 1,300 mm of water and it has to be supplied on time. Prolonged water scarcity or drought at critical plant growth stages could result in crop loss and yield reduction. Similarly, untimely or excessive rainfall could limit the entire agriculture sector.

Agriculture is the mainstay of Bhutanese economy and with about 14%, it is the fourth highest contributor to GDP (NSB, 2019). More than 58% of the Bhutanese population depends on agriculture for their livelihood. Besides helping reduce food imports, agriculture, as aspired by the government, also keeps rural life, social bond and culture vibrant (Gurung et al., 2008). However, more than 80% of the agriculture in Bhutan is rain-fed or rain-dependent, without any alternative irrigation, and therefore, the ongoing change in climate events could impinge on agricultural productivity, livelihood and the food and nutrient security (FAO, 2008).

Since climate variability is unpredictable, but with higher chances of worsening in light of growing capitalist economies, it is crucial for the sustainability of agriculture to consider applicable adaptation options in addition to mitigation strategies. Adapting to climate change related water scarcity involves taking right measures, appropriate adjustments

and changes to reduce the impact of climate change (IPPC, 2007; Akinabge & Irohibe, 2014). In light of the variability and complexity of farming systems (Shrestha et al., 2018), choice can be made from amongst multiple adaptation strategies those that would suit a specific location. The choice of strategies also has to be informed by sound understanding of the local knowledge, attitudes, practices and motivation to adopt adaptation practices (CIAT, 2017). This information in the case of Bhutan is lacking.

Therefore, this study will be conducted to (i) determine farmers' understanding on causes and impacts of water shortage, (ii) identify suitable drought tolerant native and improved crop species for Bhutanese conditions (low and mid-agro-ecological zones), (iii) assess adaptation strategies, potentials and barriers, and (iv) assess cropping practices and technologies that conserve water.

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