Regional Stakeholder Consultation on Climate Services for the Third Pole Region

Bhutan case study: Provision and use of climate services NFCS

Jaipur, India
9-11 March 2016

Department of Hydro Met Services
Ministry of Economic Affairs
Thimphu Bhutan

Outline

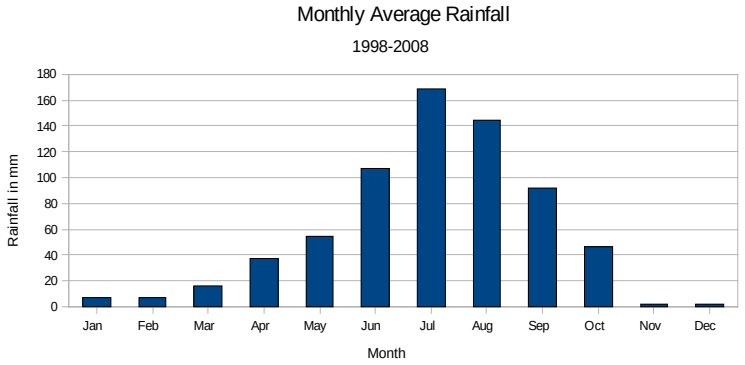
- Country profile
- Natural disaster in Bhutan
- Capacity for provision of climate services in Bhutan
- GFCS Implementation in Bhutan
- NCOF and NSC in Bhutan
- Overview of sectoral analysis/proposal on climate services
- Recommendation from NSC and NCOF
- Follow up
- Gaps and challenges
- Way forward
- Conclusion

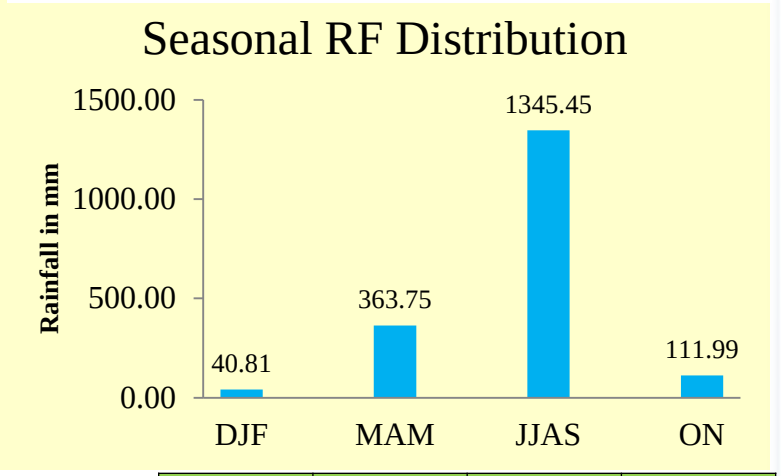
Country Profile

- Total area - **38,394** Sq. Km
- Population - **634,982** (2010) projected **720,000** (2013) with growth rate of 1.3%
- **79 %** of population is **farmer**
- Altitude : **160 m** to **7500 m** above msl
- Forest Coverage: **70.5%** - Policy is to ensure at least **60%** for all time
- Politic : Constitutional Monarchy since 2008
- Topography : Rugged mountain terrain

Monsoon in Bhutan

- Bhutan Climatic is generally dominated by monsoon winds *with dry winter and wet summer monsoon*





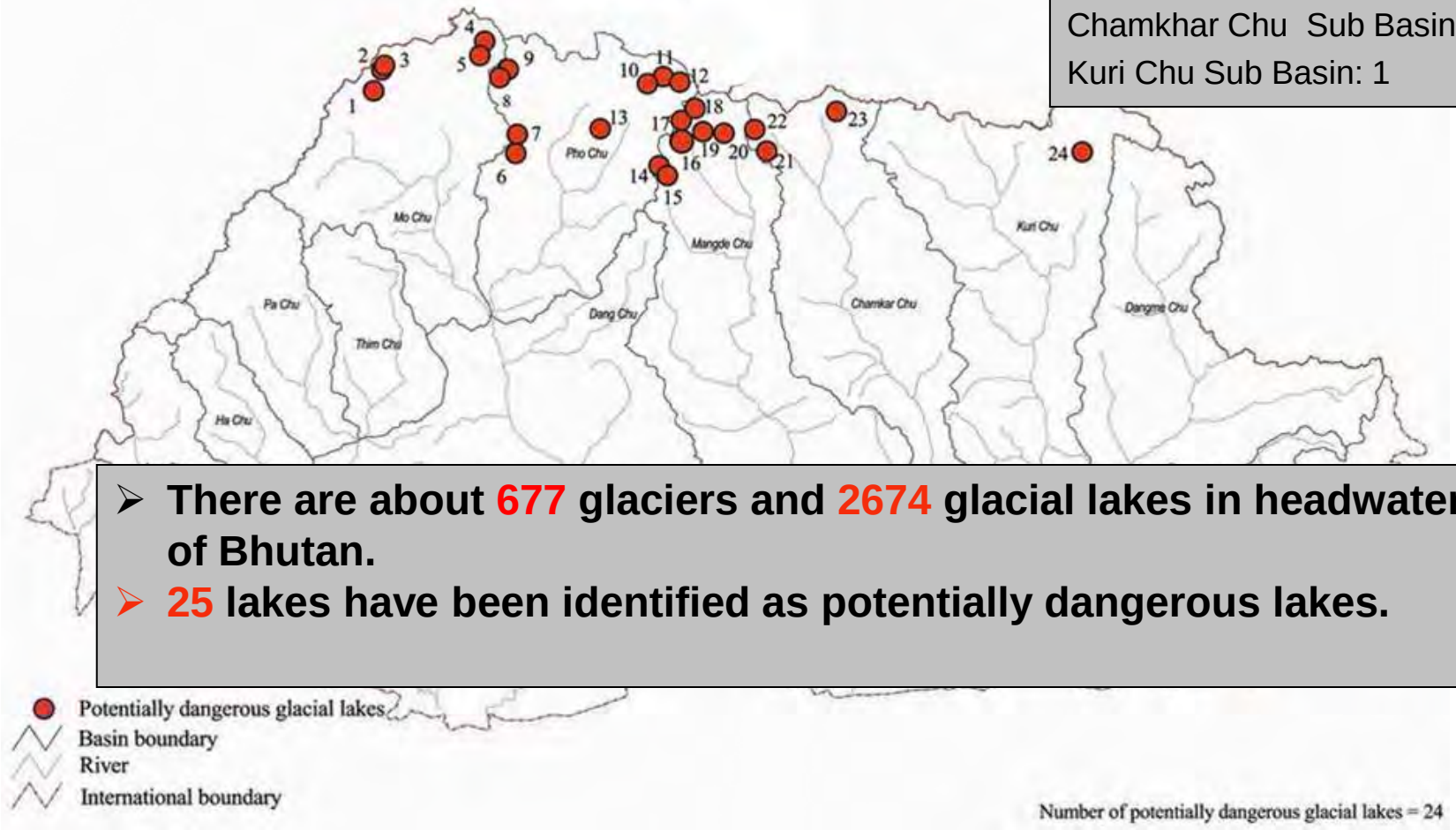
DJF	MAM	JJAS	ON
2%	20%	72%	6%

Natural Disaster in Bhutan

a. Floods
   - ✓Flash Floods
   - ✓GLOF
   - ✓LDOF
b. Windstorm
c. Landsides
d. Cyclone
e. Earthquake
f. Forest Fires
g. Epidemics, pests and diseases etc.

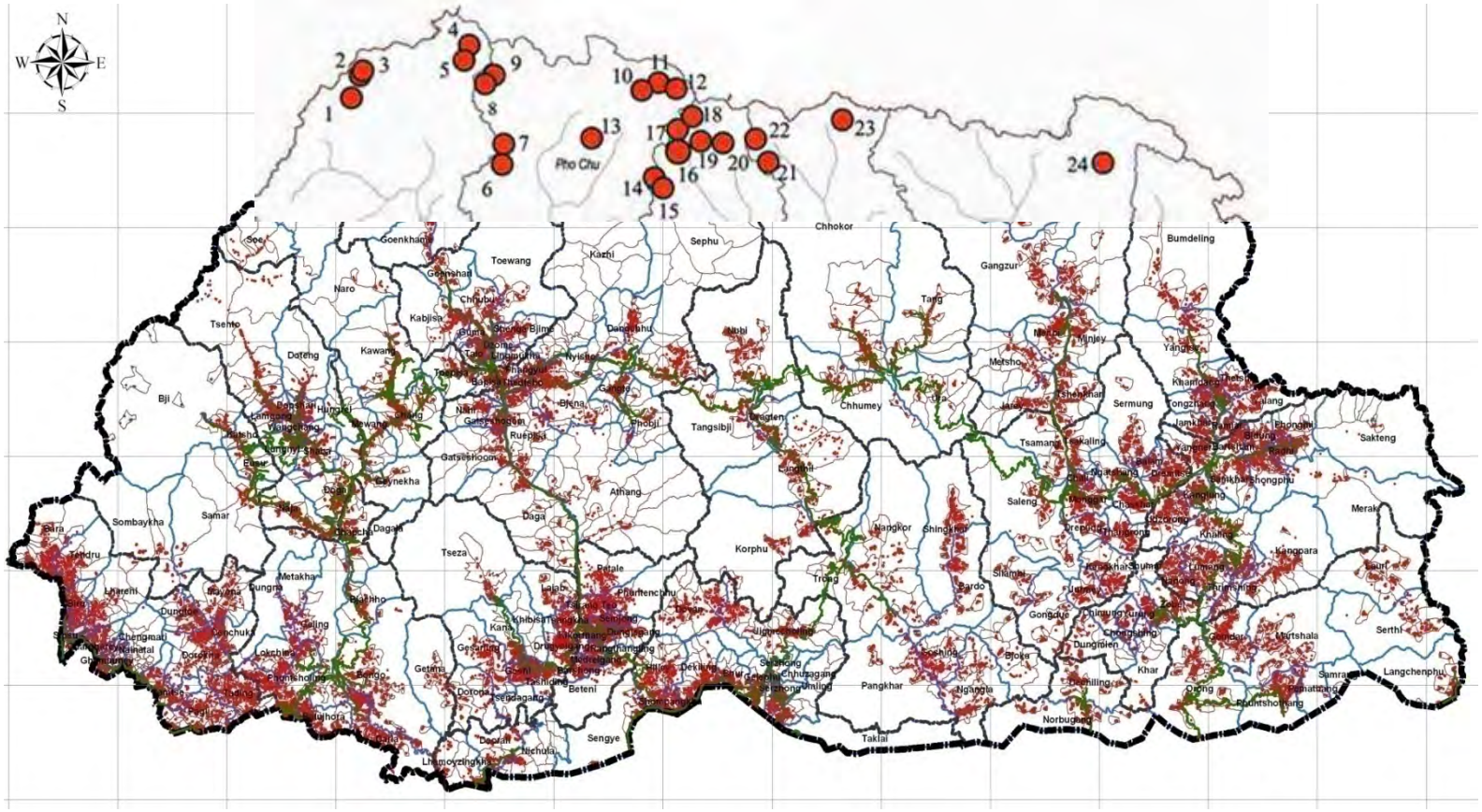
Potentially dangerous glacier lakes in Bhutan

Pho Chu Sub Basin : 9
Mo Chu Sub Basin : 5
Mangde Chu Sub Basin: 7
Chamkhar Chu Sub Basin: 3
Kuri Chu Sub Basin: 1



- **There are about 677 glaciers and 2674 glacial lakes in headwaters of Bhutan.**
- **25 lakes have been identified as potentially dangerous lakes.**

Vulnerability to climate change



Over 70% of the settlements are located along the drainage basins.

Vulnerability

International Paro

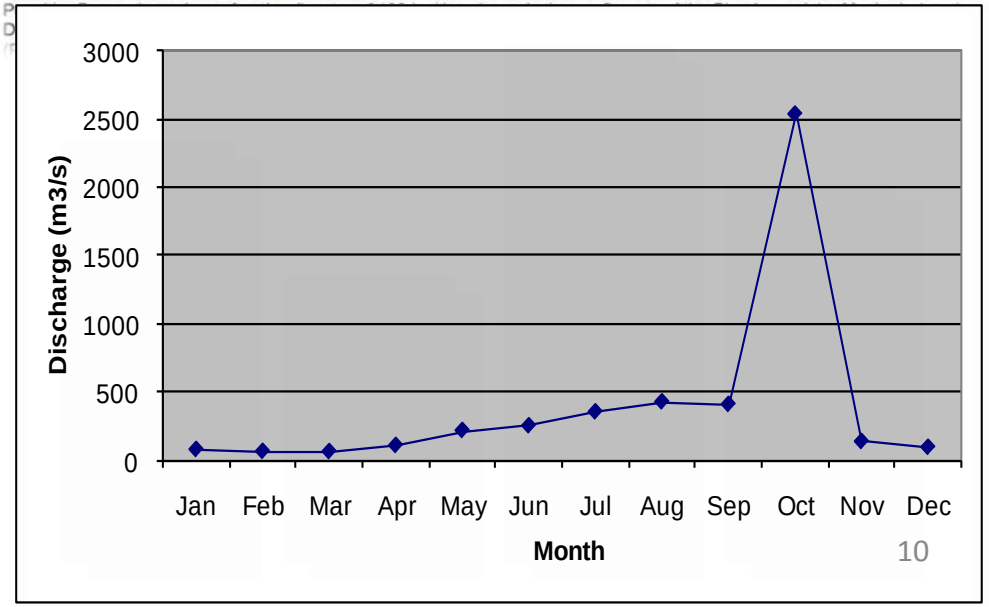
Monuments

Bumthang Domestic Airport

Hydropower Plants

Location of Airports

1994 GLOF


3000
2500
2000
1500
1000
500
0
Discharge (m3/s)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

FLASH FLOOD

Thimchhu flood during cyclone Aila May 2009

Floods impacts in Bhutan

Flash Flood: Pasakha August 2000

Flash Flood: Pasakha August 2000

Flash Flood: Intake of Ranjung Power Plant destroyed 2004

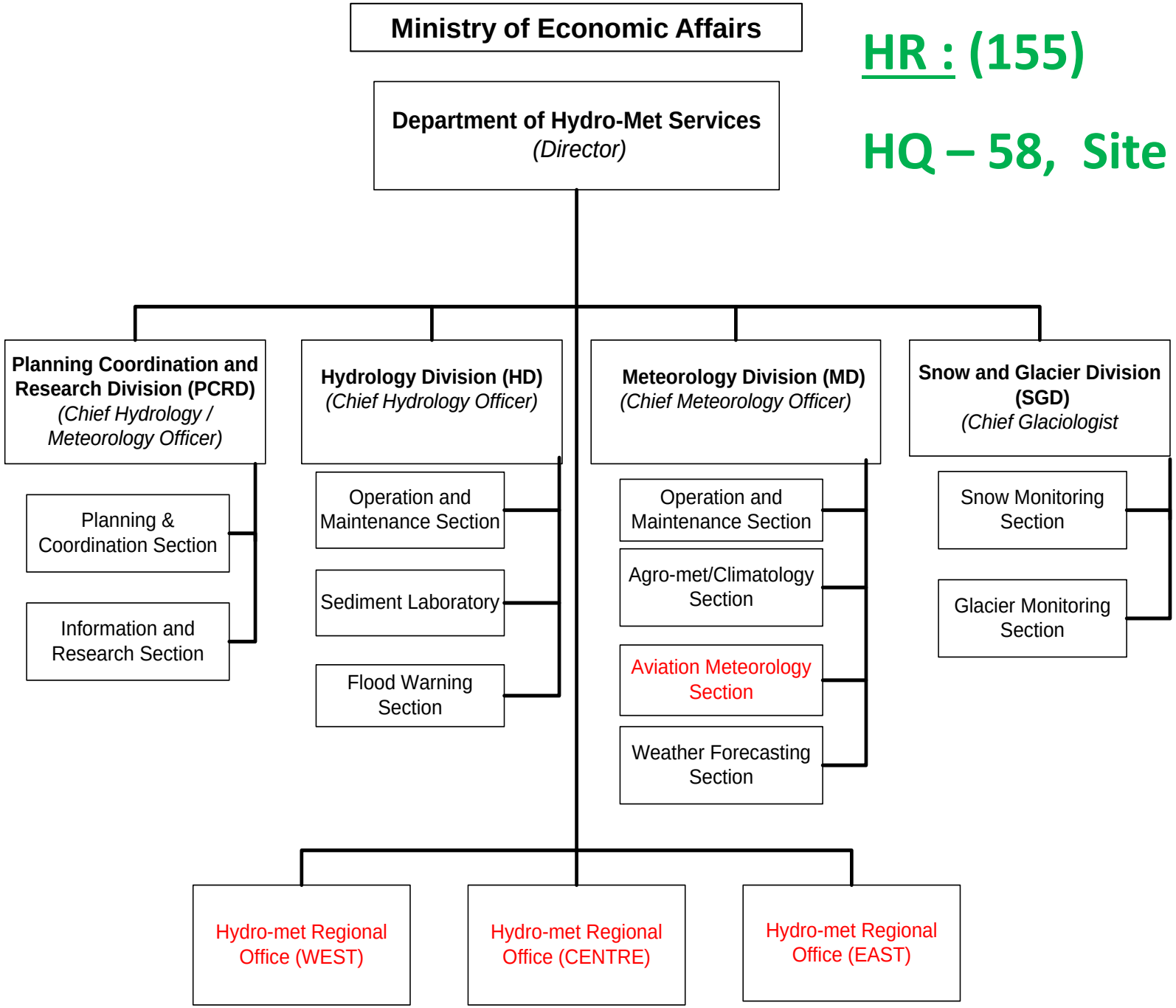
2004 Flash Flood Eastern Bhutan

12

Landslide Dam Outburst Flood (LDOF)

Tsatichhi 2004

- Landslide Dam was formed in September 2003
- Dam breached its banks in July 2004 releasing about 6000 cubic meters per second.
- Monitoring and Early warning system saved 60 MW Kurichhu Hydropower Plant down stream


Ministry of Economic Affairs
HR : (155)
Department of Hydro-Met Services
(Director)
HQ – 58, Site - 97
Planning Coordination and Research Division (PCRD)
(Chief Hydrology / Meteorology Officer)
Hydrology Division (HD)
(Chief Hydrology Officer)
Meteorology Division (MD)
(Chief Meteorology Officer)
Snow and Glacier Division (SGD)
(Chief Glaciologist
Planning & Coordination Section
Information and Research Section
Operation and Maintenance Section
Sediment Laboratory
Flood Warning Section
Operation and Maintenance Section
Agro-met/Climatology Section
Aviation Meteorology Section
Weather Forecasting Section
Snow Monitoring Section
Glacier Monitoring Section
Hydro-met Regional Office (WEST)
Hydro-met Regional Office (CENTRE)
Hydro-met Regional Office (EAST)

Capacities for provision of Climate Services in Bhutan

- Network of DHMS
  - Meteorological
  - Hydrological
  - Snow & Glacier Monitoring
- Early Warning System
- Flood Forecasting (pilot stage)
- Seasonal Prediction (winter and summer)
- Establishment of National Weather and Flood Warning Centre (NWFWC)
- 24 hours weather forecasting (upgrade 72 hours)
- WRF model (runs 4 times in a day @15 km resolution)
- Himawari 8 satellite receiving station
- Linked to GTS
- Database Management System (Hydro Met)

Network of DHMS

METEOROLOGICAL SURFACE STATION

- Agro Met Station – 20 (Manual)

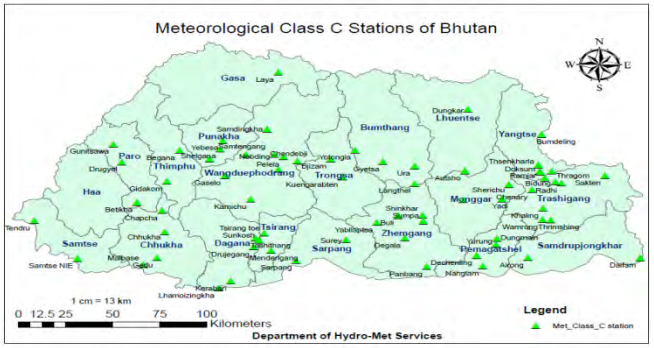
Daily measured parameter

- Rainfall
- Temperature/Humidity
- Wind
- Sunshine duration
- Soil Temperature
- Evaporation

- Climatology Station – 65 (Manual will be upgraded to AWS

Daily measured parameter

- Rainfall
- Temperature/Humidity



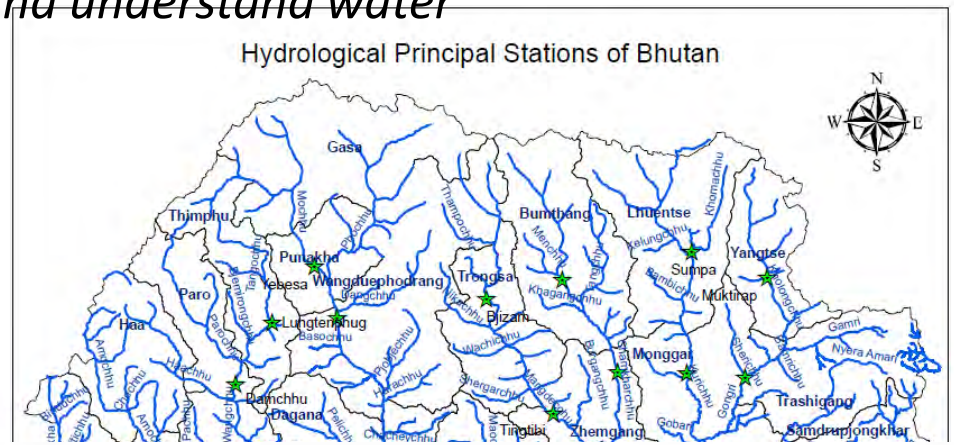
- Automatic Station – 22
  - 9 GSM
  - 10 Satellite (GPRS)
  - 3 GPRS
- Upper Air Obs= 1 (Paro)

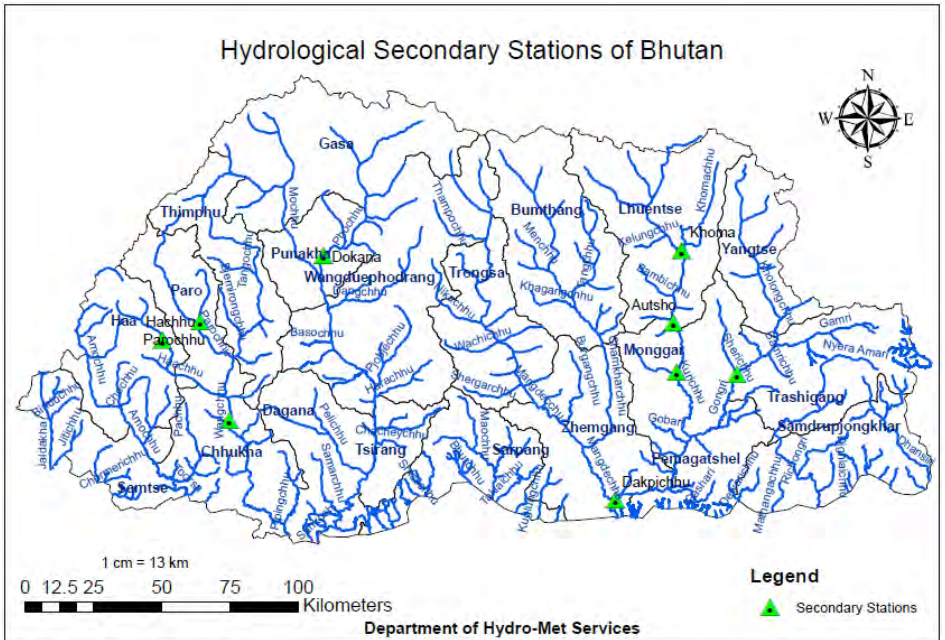
Network of DHMS cont..

HYDROLOGICAL Network : *To study and understand water*

1. Hydrological Network - 26 (upgrading and new 30 AWLS)
   - *Principal Station* *16*
   - *Secondary Station* *10*
   - *Sediment Sampling Station* *11*

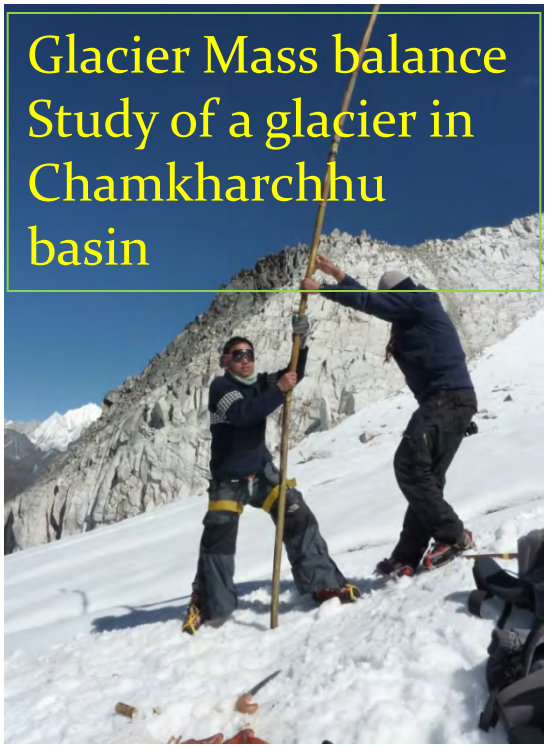
2. Flood Warning Network:
   - *Flood Warning Station* *15*
   - *GLOF Early Warning System* *03*





Snow Station Glacier works

- 19 snow manual station
- Started since 2013



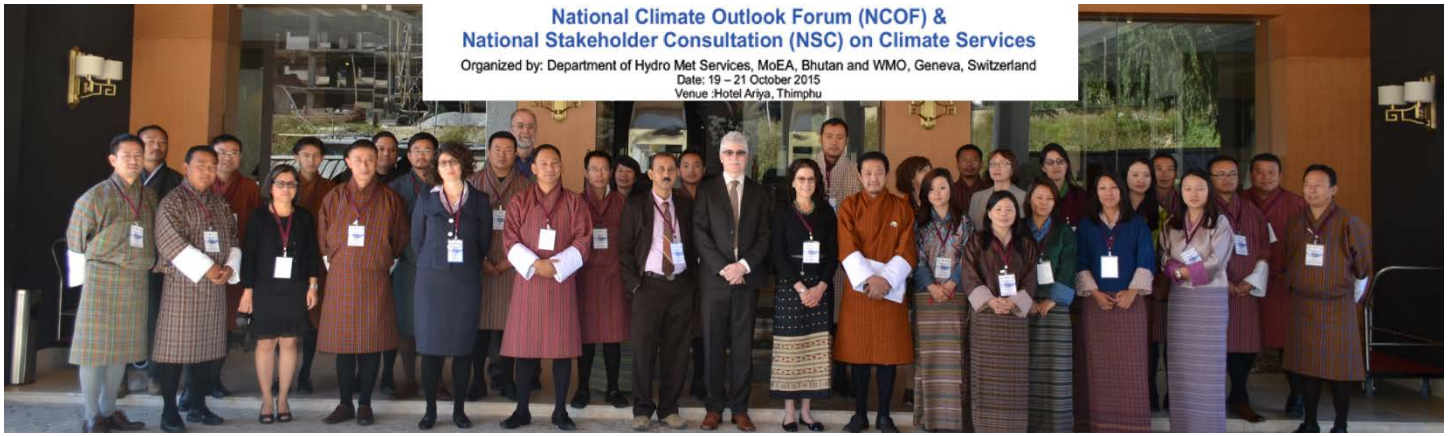
GFCS implementation in Bhutan

- WMO Regional Workshop on **Implementation of Weather and Climate-related services in Least Developed Countries (LDCs) in Asia**
- Held at Thimphu Bhutan from 9-11 September **2014**
- WMO team lead by Mr. Kuniyuki Shida, Sr. Programme Manager for Regional Coordination, DRA Department.
- LDCs member: **Afghanistan, Bangladesh, Bhutan, Cambodia, Lao, Myanmar, Nepal and Yemen.**

GFCS implementation in Bhutan

- Main objective:
  - GFCS introduction to promote contribution of weather- and climate-related services to the socio-economic development of LDCs,
  - Target Sector: agriculture, food security and rural development, climate change, and disaster risk reduction.
  - Share good practices and experiences in beneficial use of meteorological and climatological information, products and services in the socio-economic development of LDCs in Asia.
- Drafted recommendations for strengthening NMHSs of LDCs in Asia through the implementation of the WMO Programmes at National and Regional levels.
- PR Bhutan to WMO, DHMS requested WMO for technical support to implement GFCS program at National Level in Bhutan.

GFCS implementation in Bhutan



- Through WMO support, DHMS held NCOF-1 and NSC on Climate Services at Thimphu, Bhutan from 19 to 21 October 2015.
- Regional experts and WMO delegates were the resource person for the forum.
- Stakeholders from various priority areas of **agriculture, water, health, disaster risk reduction and energy** attended the forum.

Participants and Experts

Experts (Regional and WMO)

- RIMES (Thailand), India Met Department, Finnish Meteorological Institute (Finland), China Meteorological Administration, University of Bern (Switzerland), GFCS delegates from WMO

Participants

- Agriculture
  - Dept of Agriculture, National Biodiversity Centre, Ministry of Agriculture and Forestry
- Water
  - Watershed Management Division, National Environment Commission, Dept of Geology and Mines
- Health
  - Dept of Public Health, Ministry of Health
- Disaster Risk Reduction
  - Dept of Disaster Management, Royal Bhutan Army, Royal Insurance Coopetation, Bhutan Insurance Limited, Dept of Road, Dept of Human Settlement
- Energy
  - Bhutan Power Cooperation, Dept of Hydro Power, Druk Green Power Cooperation, Bhutan Electricity Authority, Dept of Renewal Energy
- UNDP, FMI, World bank

NSC Objective

- Identification of **priorities, gaps and needs**; coordination and integration of actions to be taken to address these shortcomings;
- Discussion on **benefits** from climate services at the national level for the priority sectors: **agriculture, disaster risk reduction, and hydropower**.
- Propose possible mechanism to facilitate the prioritization and coordination of activities (NFCS and NCOF)
- The NSC considers possibility of establishing and operationalizing an NFCS through, the following actions:
  - involving top level leadership, management and key players in climate sensitive sectors to provide strong institutional support;
  - strengthening the national capacity to develop and deliver climate information and services, and identifying existing gaps in the provision of climate services to the priority areas;
  - developing climate knowledge capacities in key climate sensitive government agencies and other institutions in Bhutan;
  - raising public awareness of climate variability and change;
  - operationalizing a sustainable National Climate Outlook Forum process.

Forum Outcomes

First National Climate Outlook Forum (NCOF-1)

- need to strengthen technical capacities of Bhutan to develop seasonal climate predictions;
- usefulness of DHMS staff members participating in CMA training that could be offered on the FODAS tool;
- need to hold NCOF prior to summer monsoon after SASCOF;
- need to reconstruct past climate data in Bhutan using proxy data.

National Stakeholder Consultation on Climate Services (NSC)

- strengthened understanding of both DHMS and sectoral stakeholders of climate service priorities in Bhutan;
- awareness of participants of regional and global capacities and mechanisms for providing climate services;
- Framework for Climate Services at the National Level (NFCS)
- four sectoral proposals formulated for the strengthening of the provision and use of climate services (**agriculture/biodiversity; energy/hydropower; health; and DRR).**

Overview of sectoral analyses/proposal

- **Project /Services**: Proposed Title on service requirement
- **Description**: product or services description
- **Objective**: the outcome that the use of the product or service seeks to achieve
- **Benefit**: to whom the above outcome is useful, and why, what are the benefits of using the product or service?
- **Output**: the actual form the product(s) or service(s) are delivered in, software, guidelines, data, etc.
- **Activities**: the steps needed to prepare/produce the outputs
- **Inputs**: the resources needed to conduct the activities
- **Partners**: the types of entities who need to be engaged, e.g. researchers, meteorological services, industry representatives, regulators, financers, etc.

1. Overview of sectoral analyses/proposal

SECTOR:	AGRICULTURE	Biodiversity
1. Project /Services	69% of population farmer and employing 56% of total population. Contributes 16% to GDP. Weather and climate information for making decisions in agriculture planning	Climate Sensitivity study in preserving biodiversity with special reference to Agro-biodiversity
2. Description	Provision of climate-based advisory services to farmers growing staple crops as follows: • Advisories targeted at specific crops and at different agro-ecological zones. • Forecasts on rain, temperature wind. • Agronomic practices. • Pests and disease management. • Harvests and post harvest practices	Mountain ecosystems with very diverse micro environments. To preserve this rich biodiversity, sensitivity studies on the effect of climatic parameters on the yield, growth and resistance against pest and diseases specific to a crop variety needs to be conducted. This may include ecological requirements of the existing crops and for the new crops under the changing scenarios.
3. Objective	To achieve food and nutrition security.	Identify climate sensitive areas, sensitive crops and varieties and breeds with reference to the changing climatic scenarios.
4. Benefit	• Assist farmers to decide on appropriate farming practices in coping with current climatic risks. • Increased agricultural food productivity and production. • Aid in planning and decision making processes. • Provide information for researchers and extension workers.	• NBC- capacity building for all pattern formulating action plans (NBSAP), • DOA- Policy inputs into the Renewable Natural Resources (RNR) Sector Adaptation Plans (SAPA) and all other related policy documents. • RNRRC- Identify genetic materials for developing new climate resilient varieties and breeds • Farmers- Availability of improved climate resilient crop varieties and breeds. • General Public- Food and Nutrition Security and sustainable utilization of natural resources and preservation of the environment.

1. Overview of sectoral analyses/proposal

SECTOR:	AGRICULTURE	Biodiversity
5. Output	• Agromet Advisory Bulletins • Crop Weather Outlooks • Crop yield forecast for planning appropriate interventions • Crop Weather Models, • Crop Weather Calendars • Fortnightly Aridity Anomaly Maps • Warnings for pests and diseases	Climate sensitive area maps, list of sensitive varieties and breeds.
6. Activities	• Constitute a technical working group to co-ordinate the activities. • identification of different agro-climatic zone • identification/establishment of unit responsible for issuing advisory (through research centers). • preparation of format of bulletin • establishment of observatory and communication network • training • involvement of all the stake holders in the field of agriculture • website development • Review meetings with stakeholders.	• Collection of long term series historical data on climate and crops. • Climatic projection for 2030 period. • Downscaling of climate projections for 2030. • Define climate, soil, topography thresholds for target varieties and breeds • Field Surveys. • Biophysical modeling. • Capacity development.

1. Overview of sectoral analyses/proposal

SECTOR:	AGRICULTURE	
7. Inputs	• climatic normal of met parameters • real time realised data • medium range forecast • fortnightly/monthly climate outlook • NDVI • other irrigation source • crop input: stage and state • Research and development output • Financial and human resources.	• Historical data on climate. • Historical data on crops and livestock. • Financial resources. • Human Resources. • Tools for analysis and projections. • Logistics. • Soil and DEM
8. Partners	• DoA. • RDCs, extension and Local government authorities. • DHMS. • print and broadcast media • telecom service provider • RICB/BIL.	• DoA (RDCs, Extension). • NBC. • DHMS. • Department of Livestock. • College of Natural Resources (CNR). • Ugyen Wangchuck Institute of Conservation and Environment (UWICE).

2. Overview of sectoral analyses/proposal

SECTOR:	ENERGY
1. Project /Services	• Historical data/climatological data up to 50 years • Seasonal forecast for the operation and maintenance of Hydropower Plants • Climate projections for planning design of future hydropower plants/transmission & distribution
2. Description	• Quality controlled, Time series of meteorological-hydrological variables • Seasonal forecast of rainfall & temperature • Snow melt data and Sedimentation • Information on future climate scenarios in Bhutan for expansion of renewable (Hydropower, wind, solar & biomass energy) energy • Design of Transmission & Distribution structures in Bhutan
3. Objective	• Cost effectiveness in planning, design, construction and operation of hydro projects • Optimize management of water resources in context of hydropower operation • Continuous reassessment to maintain optimal balance between power generation & downstream water for community needs & environmental flow • Sector relevant information for energy planning for medium and long term timescale • Guide future investment in Bhutan for energy sector
4. Benefit	• Efficient & effective operation of hydropower plants (operating rule and levels) • Increase flexibility in balancing power generation • better risk management/assessment • Increase resilience for preparedness of hazard downstream of dam • Maximize generation of power (using the forecast data) • Sustainable power supply (Augmentation wherever possible) • Reduce the cost of maintenance of hydropower plants (Machine breakdown) • Informed decision for energy investment (economical & political leaders) • Contribute towards achieving the goal of self-sufficiency

2. Overview of sectoral analyses/proposal

SECTOR:	ENERGY		
5. Output	• Precipitation time series including annual rainfall duration curve • Soil moisture, River flow including duration curve, wind, temperature and humidity • Soil type, Land use, Glacier volume data • Sediment (composition of bed load) including sediment rating curve		• Landslide events, Seasonal forecast of river run-off & sediment, Early warning systems • Snow melt contributions • Future scenarios of all variables • Sub-sector climate relevant information on future scenarios,
6. Activities	• downscale of reanalysis combined with in-situ observation for optimal interpolation • Evaluate the usefulness of satellite data • Improve seasonal forecast, National Climate Outlook Forum (NCOF) products • Pilot on applicability of the received data		• Model assessment & development • Analysis of global/downscaled models, • Assessment/inventory of existing global/ regionals climatic scenarios • Generate output for relevant sub-sectors • Estimate uncertainties and communication of the output (collaborate with sub-sectors)
7. Inputs	• Capacity development of DHMS • Enhance analytical skills • Expertise • River run-off model • Hydrological models		• Sedimentation model • Reservoir simulation model • Historical data for verification of models • Research on combination of different models/ information to have robust data
8. Partners	• International Climate Centers • Regional Climate Centers • Regional hydro-met Centers • ICIMOD, Nepal • RIMES, Thailand	• WMO • IMD, India • DHMS, BPC, DHPS, NEC, BEA	• Decision makers , researchers, Regulators (BEA, NEC, DoA, DoFPS, etc.) • World climate research programs • IPCC

3. Overview of sectoral analyses/proposal

SECTOR:	DISASTER RISK REDUCTION	
1. Project /Services	Disaster Information System for Bhutan	Rainfall Run-Off Modeling for Small Catchments
2. Description	**Phase 1:** A database that integrates information about past hydro-meteorological events, their causes, effects and impacts **Phase 2:** A system that evaluates impacts of future events, based on historical database	• Generation of hydrological behavior of small catchments using 10 days forecast
3. Objective	• Understanding individual hazard/disaster • Provide inputs for facilitating disaster statistics • Deriving lessons for guiding mitigation and preparedness, preventing future losses	• Provide guidance on the likely water condition in the coming 10 days • Overall reaction of small catchments of (intensive) rainfall • Provide early warning for preparedness
4. Benefit	**Department of Disaster Management:** lessons for disaster management, build back better concept **Research Institutions**: models **Insurance Companies**: basis for underwriting **Environment Commission**: input for state of environment reporting, input for baseline **Department of Engineering Services**: design criteria **Development Planners**: hazard and risk assessment for feeding into design criteria	**Department of Disaster Management**: disaster preparedness **Public Authorities**: reduction of damages and economic losses **Department of Engineering Services, Flood Engineering Management Division**: design criteria (based on long-term discharge data)
5. Output	• Events distribution map • Disaster statistics	• Rainfall discharge model • 10 days water discharge outlook

3. Overview of sectoral analyses/proposal

SECTOR:	Disaster Risk Reduction	
6. Activities	**Database design, to include GIS :** Database system development **Data collection :** Data collection guideline (to include data collection methodologies, i.e. from most recent to past) Capacity building in data collection **Quality Control** Validation of data **Data analysis** **Data dissemination**	Model development Model calibration Model testing Translation of model outputs into management strategies
7. Inputs	Dedicated personnel in DHMS, DDM, DES, NEC, DGM Hardware (computer, server) GIS software (open-source) Capacity building of relevant personnel	Dedicated personnel in DES, DHMS (in collaboration with research institutions/universities) Hardware (computer, server) Modeling software Capacity building of relevant personnel
8. Partners	DHMS DDM DES NEC DGM Insurance companies Media	DES DHMS Research institutions/universities DDM NEC DGM

4. Overview of sectoral analyses/proposal

SECTOR:	HEALTH	
1. Project /Services	• Integrated surveillance or risk monitoring for climate sensitive diseases	• Seasonal outlook for malaria control programmes
2. Description	• Pilot EW info for diarrhoea based on results from initial 4 districts (maybe for internal use) • Data collection and research on climate sensitivity for possible expansion to additional 9 districts	• Pre-monsoon outlook for vector control programme
3. Objective	• Reduced incidence of diarrhoeal cases through early warning information to the public and health authorities tested and piloted • Strengthened surveillance system • Establishment of climate-disease relationships • Research results incorporated in EWS	• Reduce/prevent malaria outbreaks • Resource efficiency and effectiveness of programmes (drainage, spraying, nets, cisterns, treatment preparation) based on expected seasonal rainfall
4. Benefit	The ultimate beneficiaries are affected **communities** who will experience improved climate-related health outcomes; in the short term the beneficiaries will be **health professionals** who will gain the knowledge necessary for the establishment of the system.	Increased **happiness**: The ultimate beneficiaries are the **communities**, who experience reduced malaria incidence; public health authorities and control programme and post-season surveillance programme benefit through resource optimization
5. Output	• Diarrhoeal health advisories, backed by communication channels, identified appropriate actions and response plans • Strengthened surveillance system (including on-going data collection, databases and analysis) • Evidence base (data and analysis) on climate-disease relationships sufficient to support EWS	• pre-season outlook including onset, cessation and total precipitation of the monsoon, at the most localized spatial resolution possible • Advisories to Community Health Action Groups • response and surveillance actions and plans incorporating outlook information

4. Overview of sectoral analyses/proposal

SECTOR:	HEALTH	
6. Activities	• Train health professionals on surveillance system • Establish data requirements and data collection protocols • Data rescue and database construction • Analyses and consultative meetings to review results • Identification of response actions and formulation of response plans • Development of health advisory prototype(s) (e.g. for communities and health professionals) • Testing of health advisory prototype and response plans	• Development of forecast tool to support outlook • Development of outlook product • Identification of options (adjustments to timing, intensity of effort, allocation of resources) for control and surveillance programmes and actions under differing seasonal scenarios • Training to control programme, surveillance programme and CHAG personnel • Testing and feedback • Incorporation into operations
7. Inputs	• Staff allocation and mobilization (e.g. from partner institutions) • Consultants • Workshops • Travel • Other (e.g. publications) • For each activity (TBD), from which a budget and timeline can be developed	• Staff allocation and mobilization (e.g. from partner institutions) • Consultants • Workshops • Travel • Other (e.g. publications) • For each activity (TBD), from which a budget and timeline can be developed
8. Partners	• DoPH, DHMS, GFCSO, WHO, university on medical sciences	• DoPH, DHMS, CHAGs, district administration, control and surveillance programmes, GFCSO, WHO, university on health sciences

Brief Summary (sectoral proposal)

Agriculture	Energy	Disaster RR	Health
• Demand on agromet service • **Capacity building** for better understanding and utilizing services • **Climate projection** for preparation and planning. • **Study** to identify **climate sensitive areas**, crops varieties and breeds with changing climatic scenarios. • Strengthening cooperation with the regional climate centres	• long term reliable historical data • Improved seasonal forecast • climate projection for design planning on future hydro power • Medium range forecast for O&M of Hydropower plan	• Database that integrates information about past hydro-meteorological events, their causes, effects and impacts • System that evaluates impacts of future events, based on historical database (statistical analysis, hazard mapping, etc.) • Strengthen working relation among the stakeholders.	• Bilateral study on CSD • Reliable seasonal prediction • Capacity development on building up Climate-Health models • Data rescue and database development

NSC Recommendation

First National Climate Outlook Forum (NCOF-1)

- NCOF should be held in Bhutan prior to the summer monsoon after SASCOF
- Lack of long historic climate data for Bhutan: reconstructed using proxy data

National Stakeholder Consultation on Climate Services (NSC)

- Explore to establish National Framework for Climate Services (NFCS) to;
  (a) investigates appropriate institutional mechanisms for guiding climate services
    - Steering Committee at the policy level;
    - Technical Committee;
    - Sector-specific working groups (agriculture; DRR; energy, health, water);

  (b) formulates a comprehensive strategy for climate services implementation; and

  (c) identifies vehicles to support project implementation (e.g. GEF, PPCR, GCF, bi-lateral)
- Staff members of DHMS and key sectoral stakeholders should be trained in project formulation techniques

Main components of a National Framework

- Legislation
- Inter-institutional coordination (Steering Committee)
- Platform for dialogue and engagement (NCOFs)
- Communication and Outreach (media)
- Capacity Development (providers and users)
- Demonstration of benefits (case examples)

Main functions of a NFCS Steering Committee

- Decision making on issues identified by the NFCS
- Provide overall guidance and oversight to the work of the NFCS
- Advocate at the appropriate levels and structures the need and value of climate services in support of adaptation and sustainable development in the country and the need for investments to be made to enable availability of high quality climate products and services.

Main functions of a National Framework for Climate Services (NFCS)

- Continuously **identifying user needs** for climate services
- **Communicating** available **climate products** and services to users in the relevant sectors
- Obtaining **feedback from users** on climate products and services
- Identifying bottlenecks in **improved delivery** of climate services
- Making policy recommendations to the NFCS Steering Committee
- Considering appropriate **mechanism for developing** climate services
- Establishing **communication channels** with relevant existing national coordination structures which function well (i.e. Agromet, Disaster Risk Reduction platforms, etc).

NFCS Follow up 1

- Capacity development
  - Training on the Climate services (Data analysis) FMI
  - Agro Met Training in IMD March 2016
  - GFCS (FODAS) Training in Beijing CMA April 2016
- Second NCOF will be held on May 2016 with support from RIMES, Thailand
- SASCOF - 8 will be attended by DHMS official on April 2016 at Srilanka supported by WMO.
- Integrated surveillance or risk monitoring for climate sensitive diseases: As proposed the DoPH will be extending the surveillance to the eastern Bhutan (climate station selected and program in progress)
- Drafting of hydro-meteorology services policy in progress
- World Bank Project: Strengthening Weather and Hydrological Forecasting and Services
  - Develop a Common Operating Platform for automated hydro-met services delivery
  - Design an agromet decision support system, generate agromet information products and disseminate to two Dzongkhags.

Follow up 2

- DHMS in process of organisation restructuring for better delivery of services.
- Recommendations and TOR's of NFCS will be put on to Multi Sectoral Task Force Committee on Climate Change (MSTFCCC) led by NEC.
- MSTFCCC meeting is scheduled to be held in mid of April/May 2016.
- MSTFCCC reports to National Committee of Climate Change (chaired by PM)

Follow up 3

- Survey on Climate services user needs by FMI expert.
  - Survey collected from the participants in the forum.
  - Requirement of historic climate data as well as future climate projection by sector is high
  - Guides on prioritizing the needs and requirements of climate services

User Survey on Climate Services

Q1 Importance of climate related issues in respective organisation

Q2 Priority climate variables in respective organisation

Q3 Importance of developing climate services in DHMS

Q4 Climate change scenario (time scale)

Q5 Requirement for spatial resolution of climate information

Q6 Requirement of temporal resolution of the climate information

Q7 What type of scenarios is required/utilize?

Q8 Mode of getting the climate information

User survey result

- High demand on gridded datasets of temperature and precipitation
- Information on future climate scenarios of Bhutan.
- Also requirements include reanalysed datasets, impact studies, hydro meteorological indices, hazard maps and events in addition to early warning and extreme weather warning services.
- High rating on the improvement and development of the climate services

Gaps and challenges

- Lack of funds, shortage of technical staff and required hardware and software required to produce climate services.
- Challenging to provide reliable/accurate climate services for rugged mountainous country.
- Weak collaboration with the stakeholders
- Use of conventional statistical approach of seasonal prediction
- Lack of expertise in **climate modeling, analysis and downscaling**
- Lack of awareness on climate service (indigenous knowledge)

Way Forward

- Held NCOF annually to discuss and share climate information with the stakeholder
- Prioritize the sectoral needs and requirement for further service delivery
- Restructuring of the organisation (ongoing) for strengthening service delivery as the key priority
- Formation of the Steering committee, technical committee (NFCS)
- centralized database management system for better service delivery
- Development of policy on the Hydro Met Services for Bhutan

Conclusion

- The GFCS events has helped DHMS and stakeholders in understanding the importance of the climate services.
- DHMS require **capacity development** for producing variety of climate services on sectoral proposals.
- **Capacity development** to **user sector** for understanding the prediction and utilizing the services
- Explore/pursue projects/technical support on fulfilling the specific sectors proposal.
- Regional collaboration and cooperation should be continued and further strengthened .
- Bilateral cooperation needs to be established on R&D for further enhancing the services (Agriculture and health)
- The production, delivery and further enhancement of the climate service will be the priority (organisation restructuring)

Thank you for your attention