



ANNUAL REPORT 2020-2021

NATIONAL CENTER FOR HYDROLOGY AND METEOROLOGY ROYAL GOVERNMENT OF BHUTAN THIMPHU: BHUTAN

2020





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Acronyms:

12 FYP	Twelfth Five Year Plan
AWLS	Automatic Water Level Station
AWS	Automatic Weather Station
DDM	Department of Disaster Management
DGM	Department of Geology and Mines
DGPC	Druk Green Power Corporation
DHMS	Department of Hydro-met Services
DIT	Department of Information Technology
EWS	Early Warning System
GEF	Global Environment Facility
GCF	Green Climate Fund
GLOF	Glacier Lake Outburst Flood
GoI	Government of India
HQ	Headquarter
ICT	Information Communication Technology
JICA	Japan International Cooperation Agency
IFAS	Integrated Flood Analysis System
LDCF	Least Developed Country Funding
MD	Meteorology Division
MHPA	Mangdechhu Hydropower Project Authority
MoHCA	Ministry of Home and Cultural Affairs
NEC	National Environment Commission
NWFWC	National Weather Flood and Warning Centre
OEM	Original Equipment Manufacturer
PHPA-I	Punatsangchhu Hydropower Project Authority- I
PHPA-II	Punatsangchhu Hydropower Project Authority- II
RIMES	Regional Integrated Multi-Hazard Early Warning System
R&D	Research and Development
RCSC	Royal Civil Service Commission
RGoB	Royal Government of Bhutan
SOP	Standard Operating Procedure
UNDP	United Nation Development Programmed
WMO	World Meteorological Organization
NCHM	National Center for Hydrology and Meteorology
WB	World Bank
WRF	Weather Research and Forecast.

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1 ORGANIZATION

The National Center for Hydrology and Meteorology (NCHM) is a scientific and technical autonomous agency of the Royal Government of Bhutan created in 2016. The Center was created to improve the efficiency and effectiveness in providing information and services related to hydrology, meteorology, cryosphere and climate science that are required by various sectors and the public.

2 GOVERNING BOARD

The Center is governed by a Governing Board (GB) with its members nominated from relevant sectors approved by the Cabinet. The GB is chaired by the Secretary, National Environment Commission Secretariat. Details of GB members are given below.

- a. Secretary, National Environment Commission Secretariat (NECS) Chair
- b. Director General, Department of Disaster Management (DDM), Ministry of Home and Cultural Affairs (MoHCA) - Member
- c. Director, Department of Agriculture, Ministry of Agriculture and Forestry (MoAF) Member
- d. Director, Department of Public Health (DoPH), Ministry of Health (MoH) Member
- e. Director, Department of Human Settlement (DHS), Ministry of Works and Human Settlement (MoWHS) Member
- f. Director, Department of Hydropower and Power Systems (DHPS), Ministry of Economic Affairs (MoEA) - Member
- g. Director, National Center for Hydrology and Meteorology (NCHM) Member Secretary

3 VISION, MISSION AND CORE VALUES

3.1 VISION

Vision

Center of Excellence in Hydrology, Meteorology and Cryosphere Science and Services

3.2 MISSION

Mission Monitoring and understanding of hydrology, weather, climate and cryosphere, for timely provision of information and services to protect lives and property and support national needs for ecologically balanced sustainable development. 3.3 **CORE VALUES** Mutual respect, cultural CORE sensitivity and non-VALUE discrimination. Professionalism in support of science, research, objectivity, impartiality, and excellence; Figure 1: NCHM Core values

3.4 GOALS

NCHM goals:

- a. Improve result-based decision support service for weather incidents and events that threaten lives and livelihoods;
- b. Enhance climate services to understand and adapt to climate-related risks;
- c. Develop capacity to provide integrated and coupled monitoring, detection and forecast services to support assessment and management of water resources and hydro-meteorological hazards;

- d. Build competence to provide sector-relevant information for socioeconomic development, and support the development of integrated environmental services to foster healthy communities and ecosystems;
- e. Sustain highly skilled professional workforce equipped with training, tools and infrastructure to fulfil the mission.

4 MANDATES

MANDATES

Provide scientific and technological services in hydrology, water resources, meteorology, climatology, and cryosphere to ensure the safety and socioeconomic well-being of society and to support national and international needs.

The detail mandates are as listed below:

- a. Planning and operation of national hydrological (surface and subsurface) and meteorological (surface and upper air) observation network and its communications systems required for monitoring and data collection;
- b. Study and monitor cryosphere (snow, glaciers, glacier lakes, permafrost) and its associated risks to implement appropriate mitigation and adaptation measures;
- c. Study and provide public weather services, severe weather warnings, meteorological data management, aviation and agro-meteorological services, and climate change information and services;
- d. Research and carryout water resources assessment, hydrological forecasting, hydrological data management, dissemination of hydrological data and information and provide early warning services related to flood and GLOF;
- e. Assessment and mapping of hydro-meteorological and GLOF hazards at the sub-basin and basin level;
- f. Capacity and human resources development through training and education;
- g. Data collection, Research and application of science and technology in operational meteorology, hydrology and cryosphere for development of services and products;
- h. Promote collaboration and institutional linkages with national, regional and international organizations related to weather, climate, hydrology, cryosphere, and water resources for exchange of data, research and technology transfer.



Figure 2: Organogram of NCHM (Approved by RCSC, August 10, 2016)

5 ORGANIZATION STRUCTURE AND STAFFING

5.1 STAFFING

There are 205 employees out of 220 total staff approved by the RCSC for 11 Five Year Plan including employees under ESP and GSP category. Four employees are currently on Extraordinary Leave (EoL).

Division/Secretariat	Approved	Existing	Gan	Remarks
	by RCSC	Laisting	Jup	Kemar K5
Secretariat	21	20	1	Including 8 Drivers and 2 ESP/GSP
Cryosphere Services Division (CSD)	8	8	0	
Weather and Climate Services Division (WCSD)	32	31	1	
Hydrology and Water Resources Services Division (HWRSD)	16	15	1	
Hydro-met Operation and Infrastructure Division (HOID)	143	131	12	Including 13 RGR (GSP) under FWS and 2 ESP under HOID.
Total	220	205	15	

Table 1: Staff strength and distribution

The detailed distribution of employees of the Center under different position categories are given in Table 2. Since the Center is responsible for monitoring and operation of national hydro-meteorological network stations covering the whole Bhutan (about 250 national hydro-meteorological stations), the maximum staff (more than 69%) are under the Support and Supervisory category followed by Professional and Management level (17%).

Position Category	No. of Staff	Percentage
a. Executive and Specialist (EX/ES)	3	1%
b. Professional and Management (P)	34	17%
c. Support and Supervisory (SS/S)	141	69%
d. Operational category (0)	10	5%
e. ESP/GSP	17	8%
Total	205	

Table 2: Distribution of staff based on Position Category:

5.2 STAFF SUPERANNUATED

Four staff superannuated during the FY 2020-2021 with more than four decades of dedicated services to the nation.

- a. Mr. Yonten Thinley Meteorology/Hydrology Technician I, S1A, HOID superannuated on 2 January 2021 after serving close to four decades. He joined the services on 1 July 1986.
- b. Mr. Tshewang Rinzin, Meteorology/Hydrology Technician I, S1A, HOID superannuated on 2 February 2021 after serving close to four decades. He joined the services on 1 March 1982.
- c. Mr. Manila Sr. Meteorology/Hydrology Technician I, S1A, HOID superannuated on 1 March 2021 after serving close to four decades. He joined the services on 1 March 1980.
- d. Mr. L B Gurung, ESP, HOID superannuated on 28 July 2020 after serving for 36 years. He joined service in 1983.

5.3 NEW STAFF

Three new employees joined the Center with effect from 1 January 2021 under single window recruitment of RCSC and one through lateral transfer. Details given below:

- a. Mr. Phachey Dampa Singye. Meteorology/Hydrology Technician joined HOID. He is posted to the Principal Hydrological station at Wangdue -Rapid (Punatsangchhu).
- b. Ms. Dechen Zangmo, Meteorology/Hydrology Technician V joined HOID and posted to Autsho Hydrological Station in Kurichhu, Lhuentse.
- c. Mr. Tashi Dendup, Procurement Officer joined the Center on 16 February 2021. Prior to the transfer, he served in Lhuentse Dzongkhag.









Figure 3.1: Staff superannuated Mr. Manila (Top right), Mr. Yonten Thinley (Top left), Mr. Tshewang Rinzin (bottom right), Mr. L B Gurung (Bottom Left)



Figure 3.2: NCHM Management with new recruits

Global Goal	Paridal Francescork for Disester Risk Reduction 2015 2030	ar Plan:		
Goal	Just, Harmonious Society enhanced the	and Sustainable rough Decentration		
Objective	Prepare and responsive society to hydrometeorol decision support services on weat	logical threats and benefits through provision of her, climate and water resources		
	Outputs will contribute indirectly to almost all the 1	6 NKRAs and is directly linked to NKRAs 6 and 17.		
NKRAs	NRKA 6: Carbon Neutrality, Climate and Disaster Resilient	NKRA 17: Sustainable Water		
SKRA	1.1 End to end National Framework for Climate Services	2.1 Access to hydrological information and understanding of national water availability improved		
	1.2 Hydro-meteorological and Cryosphere Disasters Assessed and Reduced	2.2 Water quality improved		
Programme	Programme 1: Weather and Climate Services for Building Climate Resilience	Programme 2: Enhancing Hydrology, Cryosphere and Water Resources Information and Early Warning Services		

Figure 4: NCHM 12 FYP and Linkages

6 CENTER'S 12 FYP (2018-2023)

The Center's 12th Five Year Plan (2018-2023) has two programs that are directly linked to NRKA 6 and NKRA 17 (Figure 5) and that are indirectly linked to all the NKRAs and SDG as weather, climate and water resources contributing to all the Sectors.

7 ANNUAL PERFORMANCE TARGET (APT) ACHIEVEMENT

The Annual Performance Plan Target for the FY 2020-2021 was presented to the 5th Governing Board meeting held on 12 June 2020. The FY 2020-2021 success indicators are shown in Table 2.

Sl No.	Action
1.	Climate services provided
2.	Issue Weather forecast and advisories on extreme weather events
3.	Aviation met services provided
4.	Measurement of suspended sediment loads in major rivers
5.	To provide effective and efficient directorate & services
6.	Assessment and monitoring of cryosphere and associated hazards conducted
7.	Enhancing Hydro met and Flood/GLOF warning network enhanced.
8.	Issue Flood forecast, GLOF/Flood warning/advisories
9.	Mean Annual Flow of River Basins Generated
10.	Monitoring and Transmission of hydro-met data
11.	Enhance integrity system by implementing OIP

 Table 3: Success Indicators of NCHM (FY 2020-2021)

The Center APT for the year 2020-2021 consists of 9 broad objectives, 11 actions and 11 success indicators (Table 4). The evaluation was firstly carried out in the Center by Internal Committee Review (IRC) and later by the National Technical Committee (NTC). An evaluation committee awarded an APT score of 100% (shown in Table 4) as all the success indicators were achieved.

Sl No.	Financial Year	NCHM APT Score
1	2016-2017	97.80%
2	2017-2018	99.45%
3	2018-2019	100%
4	2019-2020	99.75%
5	2020-2021	100%

 Table 4: APT Score of the Center for last five years

The Center successfully implemented the mandatory Organization Integrity Action Plan (OIP) and was awarded 98.3% for the FY 2020-2021.

APT of NCHM for FY 2020-2021 with Achievements as of June 2020								
Objective	Action	Success Indicator	Unit	Planned Activities (June 2020)	Achievements (June 2020)			
End-to-end operational National Framework for Climate Services (NFCS)	Weather forecast and advisories on extreme weather events issued	Weather forecast and advisories on extreme weather events issued)	Number	6	 National Weather and Flood Warning Center (NWFWC) operated 24/7 and daily and sub-daily weather forecasts disseminated 365 days. Extreme weather advisories issued for Cyclone TAUKAE, YASS and Others. Weather advisories/ reports disseminated on a sub- daily basis to all relevant stakeholders (Royal Office, PMO, Cabinet, Army Disaster Response, DDM, Media etc.) Operation and maintenance of weather forecasting systems and facilities (GTS, Himawari Cast and WRF) carried out and systems operational for 365 days; Common Operating Platform (SmartMEt) maintained operational Medium range weather forecast provided 			

Table 5: NCHM APT for the FY 2020-2021 and Achievements

Climate services	Climate	Number	10	1 National Climate Forum (NCF) conducted:
cinitate services	Cilliate	Truindel	10	2. Second and disting (assume section).
provided	services			2. Seasonal prediction (summer outlook) developed
	provided			and provided;
				3. Seasonal prediction (winter outlook) developed and
				provided;
				4. Completed climate monitoring (annually)
				5. Historical climate information and data provided;
				6. Updated weather and climate information on the
				NCHM website:
				7 Completed the Climate monitoring (monthly).
				8 Weather and seasonal information for agro-met
				services provided.
				9 Completed the quality control of agro-met data
				10 Completed a data rescue matadata data archival
				for the year 2020
				11 Completed quality control of elimetale given data
				for the year 2020.
Aviation met	Aviation met	Number	4	1. Operated and maintained aviation methodological
services provided	services			observation equipment at all airports,
	provided			2. Meteorological observations and reports
				(METAR/SPECI) generated every 30 mins and
				shared with International Civil Aviation
				Organization (ICAO) and Air Traffic Control
				Room and Airlines;
				3. Up-gradation of meteorological observation
				equipment of Gelephug, Bumthang and Yonphula
				airports completed
				4. Aeronautical climatological information provided
				5 AWS installed at Ponchula Mongar
				5. A Wishingtaned at Fonenula, Wongar

Water quality improved	Measurement of suspended sediment loads in major rivers	Measurement of suspended sediment loads in major rivers carried out	Date	1	Sediment sampling station and sediment laboratory established at Doksum, Gongrichhu.
To provide effective and efficient admin, direction and related common support services	To provide effective and efficient directorate & services	Provided effective and efficient directorate & common services	Days	3	 Services delivered as per the RCSC minimum standards for service delivery. Services delivered as per financial norms and requirement Support services including web update, provide internet services through networking and basic ICT support to all staff in NCHM provided. Administered and supported operation of ITC systems of Center such as GTS systems, Hydro- met Database, Himawari Satellite System, WRF, SMART-Met, and other manual and automatic station's receiver server.
Hydro- meteorolog ical and cryosphere disasters assessed & reduced	Assessment and monitoring of cryosphere and associated hazards conducted	Assessment and monitoring of cryosphere and associated hazards conducted	Number	3	 Annual measurement and monitoring of glaciers, glacier lakes and associated hazards completed. 1. Annual monitoring of Thana Benchmarked Glacier. 2. Annual monitoring of Gangju La Benchmarked Glacier. 3. Time Series Monitoring of Thorthormi Glacial Lake. 4. Bhutan Glacial Lake Inventory (BGLI) 2021 5. 5. Mass Balance Status of Glaciers of Bhutan Himalayas

	Hydro met and	The critical	Number	7	1. Maintenance & shifting of weather & climate
	Flood/GLOF	hydro-			stations (both Manual & Automatic).
	warning network	met/GLOF			2. Construction of Site Office at Pangbang,
	enhanced.	infrastructures			Zhemgang 60% completed but impacted by
		& network			COVID pandemic;
		enhanced &			3. Construction of Site Office at Gakiling, Haa,
		maintained			completed (30%) but impacted by COVID19
					pandemic.
					4. Maintenance Chamkhar & Kurjey Office
					completed;
					5. Maintenance and rehabilitation work of
					hydrological stations and infrastructures
					completed;
					6. Maintenance work of GLOF Early Warning
					systems and infrastructures completed and report
					submitted.
					7. Procurement of Spare parts for the Hydro-met
					Stations (AWS, AWLS, GLOF and Manual
					Station) completed:
					8. Retaining all for Duksum hydrological station on
					Gongrichhu competed.
					9. Renovation of office building at Thrimshing 90%
					completed.
					10. Fencing work at Sherichhu Site office completed.
	Assessment of	Assessment of	Number	1	1. Preliminary flood hazard map of Thimchu
	hydro-logical	hydrological	1,01110,01	*	developed based on the request to RBG and
	hazard conducted	hazard			Warning level setup on Dechencholling Bridge
		conducted			thanning lever betup on Deenenenonning Diluge.
1	1	conductou.	1		

 	7				
Flood forecast,	Flood forecast,	Number	5	1.	24/7 Flood Monitoring and Command Room of the
GLOF/Flood	GLOF/Flood				NWFWC operated and flood advisories and report
warning/advisorie	warning/advis				issued to stakeholders;
s issued	ories issued.			2.	24/7 GLOF EWS Control Room for
					Punatsangchhu, Mangdechhu and Chamkarchhu
					operational and provide flood warning services to
					stakeholders.
				3.	Issued Flood/GLOF Early warning during cyclone
					AMPHAN.
				4.	Education and awareness on GLOF/Rainstorm
					EWS conducted for Punatsangchhu and Chamkhar-
					Mangdechhu basins for relevant stakeholders.
				5.	Awareness posters and brochures for Interim Early
					Warning Flood System of Ammo Chhu Basin.
					Bijzam Flash Flood and Breach of a subsidiary lake
					at Thorthormi developed and disseminated during
					the WMO Day Celebration 23 March 2021
				6	Flood Warning Level for Thimphuchhu at
				0.	Dechencholling bridge setup and trained RBG for
					observation
					observation.
		1			

Access to	Mean Annual	Mean annual	number	3	1. Hydrological data from the National Hydrological
hvdro	Flow of River	flow of main		-	Observation networks collected, processed and
logical	Basins Generated	river basins			archived in National Hydrological Database,
information		generated			2. Annual Hydrological Data Book 2020 published.
and		C			3. Channel Rating and Rating Curve for AWLS
understandi					development
ng of					4. Hydrological data and information shared based on
national					the request.
water					5. River basin characteristic and hydrological
availability					Information (DEM, Airel image, multiple cross
improved					section, geo-database, etc.) Thimchhu river for
					Lungtenphug Principal Station completed.
	Monitoring and	Monitoring	Days	30 days	1. Hourly (monsoon) and daily water level data
	Transmission of	and			transmitted from all the Principal and Secondary
	hydro-met data	Transmission			Hydrological network stations to the 24/7 Flood
		of hydro-met			Monitoring and Command Center (FMCR) of
		data to HQ			National Weather and Flood Warning Center
					(NWFWC) for flood forecasting and warning
					services;
					2. Data from the Automatic Water Level Stations
					(AWLS) and GLOF EWS automatically
					transmitted to systems and archived in a database
					(DMS).
					3. Daily observation data of manual hydrological
					stations recorded in prescribed form transmitted to
					HQ at the end of every month for entry in the
					database from the sites.

8 SUMMARY OF FINANCIAL STATEMENT

8.1 BUDGET APPROPRIATION FOR THE PAST FOUR YEARS

The total budget allocated (RGoB + Donors) to the Center for the last four years and its expenditure for the FY 2020-2021 is shown in table 5 and table 6 respectively.

Sl. No.	Funding	2016-2017	2017-2018	2019-2020	2020-2021
1	RGoB	55.0	76.87	110.063	115.893
2	Donor (GoI, World Bank, GCF, PHPA, etc.)	250.6	117.93	64.290	48.533
	Total	305.6	194.80	170.353	164.426

8.2 FINANCIAL SUMMARY FOR THE FY 2019-2020

Sl.	Funding	202	Budget	
No.		Approved	Expenditure	Utilization in
				Percentage
1	RGoB	115.893	105.048	80%
2	Donors (GoI, World Bank,	64.290	26.904	
	GCF, PHPA and others)			
	Total	164.426	131.952	

 Table 7: Expenditure for the FY 2020-2021

9 HIGHLIGHTS OF CLIMATE FOR THE YEAR 2020

9.1 ANNUAL RAINFALL

The annual average rainfall (area average) was recorded 2076.7 mm in 2020. The country as a whole received near normal to slightly above normal rainfall against the long-term average. The highest 24-hour rainfall was recorded at Bhur with 512.1 mm. Gasa experienced the highest number of rainy days with 214 days (rainy days is defined as rainfall greater than or equal to 1 mm). It is to be noted that a greater number of rainy days does not translate to more accumulated rain. Similarly, the highest total annual rainfall was recorded at Bhur with 7220.3 mm followed by Sipsoo with 6324.2 mm.

9.2 MAXIMUM AND MINIMUM TEMPERATURE

The annual average maximum temperature was recorded 22.0°C and minimum temperature was 11.8°C. The highest daily maximum temperature was recorded at Punakha with 37.5°C and the lowest daily minimum temperature was recorded at Haa with -12.0°C. Haa experienced a greater number of days with the minimum temperature below or equal to zero with 127 days (minimum temperature <=0).

9.3 MONSOON 2020

Bhutan experiences the summer monsoon from June to September. Bhutan receives most of its annual rainfall during summer monsoon so, it is one of the predominant seasons of the year that influences much of the climate in Bhutan.

9.3.1 Rainfall

During the summer 2020, the country as a whole received near normal to slightly above normal rainfall. However, during the months of July, August and September, most of the stations received slightly above normal rainfall against the long-term average 1996-2019.



Percentage departure of JJAS 2020 observed rainfall from mean



Figure 5: Observe Rainfall of 2020 (JJAS) with long term average (1996-2019) (Top) and percentage departure of observed JJAS rainfall from mean (Bottom)

9.3.2 Temperature

During the summer 2020, the country as a whole received near normal average temperature against the long-term average 1996-2019.







10 HIGHLIGHTS OF HYDROLOGY FOR THE YEAR **2020**

10.1 River Flow Status of Bhutan

The annual average flow of 27 years (1992-2019) is compared with the average flow of 2020 for the five Principle hydrological stations. Each station is located in different basins but does not serve as a representative flow of the entire basin.

The average flow of all the stations under consideration for the year 2020 shows slightly below the annual average of the past 27 years.

10.2 Monthly Flow Monitoring

The flow statistics (mean, max and min) of 2020 were compared with historical flow statistics of Lungtenphu on Thimchhu, Kerabari on Sankosh, Kurjey on Chamkharchhu and Wangdirapids on Punatsangchhu stations and are updated monthly and uploaded in the NCHM website and can be access from this link. (https://www.nchm.gov.bt/home/pageMenu/838).



Station: Lungtenphu on Wangchu

Station: Tamchu on Wangchu





Figure 8: River flow statistic for Punatsangchhu (Wangdirapid station) and Chamkarchhu (Kurjey Station)

10.3. Extreme Event

The Bjizam hydrologic station on Mangdechhu is located upstream of Mangdechhu Hydropower Project Dam. The station is also one of the flood monitoring stations for the Rainstorm/GLOF Early Warning System of Mangdechhu basin installed in 2016 under the JICA supported project.

The flash flood from the Chamdey Gangchhu stream (a tributaries of Mangdechhu located approximately 300 meters away from Thimphu-Trongsa National Highway bridge), which occurred on October 1, 2020 (at around 17:30) dammed the main Mandechhu river. The backflow and artificial lake submerged the Bjizam hydrological station. The monitoring station and communication equipment were damaged beyond repair. Dzongkhag Administration, Trongsa carried out the dredging work, but the water level was not lower and the station is still under submergence and could not restored.



Figure 9: Aerial Image showing the flash flood Site of Bjizam





Figure 10: Bjizam Hydrological Station submerged and damaged by October 2020 Flash Flood

Highlights of Accomplishments For the FY 2020-2021
11 NATIONAL FRAMEWORK FOR CLIMATE SERVICES (NFCS)

The Weather and Climate Services Division of the Center is responsible to study and provide public weather services, severe weather warnings, meteorological data management, aviation meteorology, agro-meteorology and climate change information and services.

11.1 WEATHER FORECAST

The National Weather and Flood Warning Center (NWFWC), Thimphu operates 24/7 and monitors weather conditions of all the 20 Dzongkhag and issue routine daily weather forecasts through Bhutan Broadcasting Television (TV), radio and social media (Facebook page:

https://www.facebook.com/NationalCenterforHydrologyandMeteorology/).

Based on severity of weather, the Center also issues weather advisories and weather updates from time to time. The daily short-range forecast for the 20 Dzongkhag includes precipitation outlook with maximum and minimum temperature. The Center also provides special weather forecasts based on the user's needs and requirements.



Figure 11: Weather forecast map of Bhutan (26 May 2021)

11.2 CYCLONIC UPDATES

NWFWC monitor Cyclonic activity and issues warning and advisories to the public.

Sl No.	Event	Category	Date of weather warning issued
1.	Cyclone Tauktae	Very Severe Cyclonic Storm	• Warning issued on 18th May, 2021 at 16:00 PM
2.	Cyclone YAAS	Very Severe Cyclonic Storm	 Warning issued on 24th May, 2021 at 11:00 AM Cyclone update 1 issued on 25th May, 2021 at 17:00 PM Cyclone update 2 issued on 26th May, 2021 at 16:00 PM Cyclone update 3 issued on 27th May, 2021 at 16:00 PM Cyclone update 3 issued on 28th May, 2021 at 10:30 AM

 Table 8: Cyclonic Warning and updates issued by the Center

11.3 CLIMATE DATA AND INFORMATION SERVICES

The Center provides climate data and services including climate data processing, quality control, analysis and archival. The data is provided to user sectors and individuals as per their request. The Center produced monthly and annual climate monitoring reports, and seasonal forecasts. All the reports are updated on our website.

11.4 NATIONAL CLIMATE OUTLOOK FORUM (NCOF-7)

The Seventh National Climate Outlook Forum (NCOF-7) was held on 21st May, 2021 via video conferencing due to covid-19 pandemic. This forum serves as a platform for guiding the development and application of climate information in decision-making in climate-sensitive sectors. NCOF is one of the main annual programs of the Center, where seasonal outlook for the monsoon are discussed and issued.

Center released the outlook of Summer Monsoon 2001 (June-September). The final outlook of summer monsoon of Bhutan for JJAS 2021 based on the forecast of climate predictability tool, considering the consensus outlook of SASCOF-19 and outlook from various other sources. The rainfall forecast during the summer of JJAS 2021 will most likely be normal to slightly above

normal. The maximum and minimum temperature will most likely be normal to slightly above normal. It is to be noted that the forecast provided is an average across the country therefore, slight deviations in the forecast are expected from the point or stations wise forecast.

NATIONAL CENTER FOR HYDROLOGY AND METEOROLOGY THIMPHU: BHUTAN r of Braillance is Hydrology, Meteorology and Dynaphare Science and B 23 May, 2821 Press Release Procipitation and Temperature Outlook for Southwest Summer Measure (June - September, 2021) The National Center for Hydrology and Meteorology releases the earlock for precipitation and temperature for the 2021 summer season, for the months of June to Semember 2021. This year due to the pundersic, the 7th session of National Clanate Outlook Forum (NCDF-7ewas held virtually on 21 May 2021. The presentation of the matheek was made to all the statisfacidors and media. The forware way prepared using a statistical model (Clinical Predictability Tool) with inputs of the GCM) data. The fired outlock is also based on the conservational without of the South Asias Climate Outlock Forum (SASCOF-19) held virtually from 26 - 28th April, 2021, and outlook from WMO GPCs and various other scarsios. Similar to best practices in other countries, the screener monseen outlink has to be snal along with the extended range forecess, doily weather forecesis and other advisories released by the Center. Sustativities and sites are advised to follow the NCHNI website and Excebook pages for advisories and updates. Rainfull Forecast for 2021 Summer Season Normal is the average minifull dir the summar sensor (IJAS) of ithman from 1996 to 2020. The summer rainfall for Bhatan during 2021 JUSS memory search is most likely to be normal to slightly obove normal. Ratefull is likely to be similar to beet year. Temperature Ecrecust for 2121 Summer Season Normal is the average surgentiate tractionen and minimum for the summer sensor (BAS) of Bitatan from 1996-2020. The maximum and minimum sumpristance in Bluman during the 2021 JUNS. moreous secon is likely to be soreal to slightly above soreal. Summer secondaries is also expected to be similar or slightly summer than hor year. Prot Box No 201, 361: +935-2 324999; Fail > 975-2 325938 Enally waldrahugeds: Webster generation on th

Figure 12: Press release issued for JJAS, 2021

11.5 AGRO-METEOROLOGICAL SERVICES

The Center provides weather and climate information to develop agro-met services for farmers. The Center is also one of the implementing partners of the GCF Project: **Supporting Climate Resilience and Transformational Change in the Agriculture Sector in Bhutan** to develop and enhance agromet services and products.

11.6 CLIMATE DATA USERS

The Center is responsible for collecting and maintaining the national climate data repository. The Center provides climate data and information to Government line agencies, private sector, academic researchers and students, corporate sector, foreign institute and others based on the request.



Figure 13: Climate Data requested by users for the FY 2020-2021

11.7 AVIATION METEOROLOGICAL SERVICES

The Aviation Met Section maintains and operates airport weather stations at all aerodromes of the country, Paro International Airport and three domestic airports, to provide meteorological information for international and domestic flights as well as for helicopter services. Aviation Meteorological Section successfully completed the routine as well as ad hoc maintenance of all the weather observation stations in the airports.

Date	Airport name	Details of maintenance
		work carried out
8 th - 10 th August, 2020	Gelephu domestic	Half yearly inspection and
	airport	maintenance
21 st - 23 rd October, 2020	Yongphula domestic	Half yearly inspection and
	airport	maintenance
25 th - 27 th October, 2020	Bumthang domestic	Half yearly inspection and
	airport	maintenance
5 th - 7 th March, 2021	Bumthang domestic	Annual maintenance
	airport	
9 th - 11 th March, 2021	Yongphula domestic	Annual maintenance
	airport	
6 th - 9 th March, 2021	Gelephu domestic	Annual maintenance
	airport	

 Table 9: Details of AWOS Maintenance at the airports

11.7.1 INSTALLATION OF WIND DIRECTION INDICATORS

As per the requirement of ICAO, Aviation Met Section successfully installed the frangible wind direction indicators, 2 numbers each at all airports. The mast has a unique brake system incorporated which is compliant to ICAO (aerodrome Annex 14).

 Table 10: Details of Wind Direction indicators installed at the airports

Date	Airport name	Description
14 th - 17 th April, 2021	Bumthang domestic airport	Installed the wind direction indicators
19 th - 23 rd April, 2021	Yongphula domestic airport	Installed the wind direction indicators
1 st - 5 th May, 2021	Gelephu domestic airport	Installed the wind direction indicators

11.7.2 INSTALLATION OF AWS AT PONCHULA

On the request of the Dzongkhag Administration, Mongar through the Department of Air Transport (DoAT), Ministry of Information and Communication (MoIC), the NCHM installed AWS at Ponchula, Mongar on

May 1, 2021 for the feasibility study of domestic airport. Installation was delayed due to non-availability of funds and COVID19 pandemic.



Figure 14: AWS at Ponchula, Mongar



Figure 15: Awareness of Local People after installation AWS at Ponchula

12 HYDROLOGY AND WATER RESOURCES SERVICES

12.1 CHANNEL RATING OF AWLS SITES FOR RATING CURVE DEVELOPMENT

Stage-discharge rating curves are used to produce discharge data. The shape of these curves is dependent on the shape of the channel that controls flow. Changes in rating curves occur over time in response to transitory (e.g., vegetation, ice, debris) or persistent (e.g., aggradation/ degradation) changes of the rated channel which can be natural or man-made. A one-time low flow measurement of the river is carried out along with the channel section to establish initiation of rating curve development.



Figure 16: River Cross Section Survey of AWLS station

12.2 AWARENESS ON GLOF/RAINSTORM FLOOD EARLY WARNING SERVICES

Education and awareness of local governments and stakeholders of GLOF/Rainstorm Flood Early Warning Systems of Punakha-Wangdue and Chamkhar-Mangdechhu Valleys carried out before the monsoon from 17th June, 2021. However due to the pandemic the awareness program was focused only for relevant Dzongkhag officials' and stakeholders of Punakha, Wangdi, Trongsa and Bumthang Dzongkhag and Hydropower Project Authority.

Sl. No.	Basin	Dzongkhag	Location	
1	Punatsangchhu	Punakha	PHPA 1 and PHPA 2	
			Wolathang Primary School	
			Punakha Dzongkhag Administration	
		Wangdue Phodrang	Wangdue Phodrang Dzongkhag Administration	
			Basochhu Hydropower Plant	
		Gasa	Gasa Dzongkhag Administration	
2	Mangdechhu	Trongsa	Trongsa Administration	
			Bjeezam Primary School	
3	Chamkharchhu	Bumthang	Bumthang Dzongkhag Administration	
			Bathpalathang Airport	
			Gangrithang Primary School	
			Choekhartoe Primary School	

Table 11:	Awareness	on the	GLOF/Rainstorm E	WS
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Figure 17: GLOF EWS Awareness Meeting with Trongsa and Bumthang Dzongkhag Administration

12.2 AMMOCHHU FLOOD CONTROL ROOM, PHUENTSHOLING

An interim 24/7 Flood Monitoring Control Room (FMCR) of Amochhu basin was set up in the new DGPC Building in 2020. Since the DGPC building is identified as the COVID19 isolation facility, NCHM was directed by the South COVID-19 Task Force (SC19TF) to relocate the Flood Control Room from DGPC building. Accordingly, with the support from Phuentsholing Thromde, 24/7 Flood Monitoring Control Room (FMCR) was relocated to the old YDF building located near the confluence of the Omchhu. Relocation work was carried by a Technical Team deputed from 11 June to 21 June, 2021.



Figure 18: Interim Flood Control Room Shifted to YDF Building

12.1 INTERIM MANUAL FLOOD WARNING LEVEL ESTABLISHED ON THIMCHHU

An interim flood warning level for Thimchhu at Dechencholling bridge was established to provide the flood early warning information to downstream. Warning levels were fixed based on the hydrological modelling and field work carried by a technical team from NCHM.



Figure 19: Field Work for the setting up of river gauge post, flood

12.2 DISSEMINATION OF HYDROLOGICAL DATA

The Center also provides hydrological data to Government agencies, private sector, academic researchers and students, corporate sector and others private as per the "Guidelines on the Exchange and Dissemination of Hydrometeorological Data and Information" based on the request.



Figure 20: Hydrology Data request by different users for the year 2020-2021

13 NATIONAL HYDRO-MET OBSERVATION NETWORK

13.1 ANNUAL MAINTENANCE OF HYDRO-MET OBSERVATION NETWORK

The Center operates and maintains the National hydro-met observational network that consists of 289 stations across the whole country. The National hydro-met network includes the following:

- a. Meteorological Station Network
- b. Hydrological Station Network
- c. Flood/GLOF EWS
- d. Flood Warning network supported by GoI.

Sl. No.	Type of Monitoring Station	Number
1	Meteorology Station	173
2	Hydrological Station	100
3	Sediment Sampling Station	16
	Total	289

Table 12: Status and types of hydro-met station

The annual maintenance works of the stations includes, among others, troubleshooting, replacement of sensors/equipment, calibration of sensors, installation and upgradation of selected hydro-met stations etc. The maintenance team could not cover the stations located along the southern border due to covid-19 restrictions and minor maintenance were carried out by the respective field observers. Annual maintenance works for the national hydro-met observation network was completed and status shown in Table 12.

Sl No.	Station Category	Station Type	Total Maintenance in 2019-2020 FY	Total Maintenance in 2020-21 FY
1	GLOF-EWS	Automatic	15	15
2	Hydrological Stations	Manual	19	20
3	Hydrological Stations	Automatic	42	36
4	Meteorological Stations	Manual	20	20
5	Meteorological Stations	Automatic	82	15

 Table 13: List of stations maintained in 2020-2021

The Center successfully completed annual lean flow measurement of the 45 un-gauged streams covering the whole country.

13.2 CONSTRUCTION OF SITE OFFICES AND FENCING

- a. The construction of a site office at Karmaling under Dagana Dzongkhag was completed and formally taken over by the Center on 20 February 2021. The work was a spillover activity of FY 2019-20 due to the COVID 19 pandemic.
- b. Renovation of Site office at Sherichhu and cableway shed at Doksum on Gongrichhu was a spillover from FY 2019-2020 due to the pandemic and were completed and taken over by the Center on 25 February 2021.
- c. Construction of boundary fencing and water supply at the regional office, Bumthang and construction of boundary fencing at Tang completed and taken over by the Center on 07 October 2020.
- d. The Renovation of Staff Quarter at Kurjey and Chamkar, Bumthang were completed and taken over by the Center.
- e. The boundary fencing work at Sherichhu Site office completed.
- f. Retaining wall construction at Doksum hydrology station of Gongrichhu completed at contract price of Nu. 309,182.00.
- g. The Construction of Flood Monitoring Office for Ammochhu at Gakiling Haa awarded to M/s Norzang construction for a contract amount of Nu. 34,65,852.14. The construction work spillover to the FY 2021-2022 due to the pandemic situation. Aorund 30% of work is completed at the end of June 2021.
- h. Construction of Site Office with Sediment Laboratory at Panbang, Zhemgang awarded to M/s SD construction for a contract amount of Nu. 2,782,500.420/-. The construction work was spilled over to FY 2021-2022 due to the pandemic situation. About 60% of work is completed by the end of June 2021.
- i. Relocation of AWS station at Dorji Goenpa, Trongsa was awarded to M/S Yeg Nang Bandura for a contract price of Nu.142657.2. The construction was completed and taken over by the Center on 23 April 2021
- j. Renovation of the Flood Warning Site Office at Thrimshing, Trashigang was awarded by the Department of National Property (DNP), MoF directly to M/s Housing and Infrastructure Management Firm. However, the work was delayed and spillover to the FY 2021-2022 due to COVID-19 pandemic.



Figure 21: Chamkhar Met Site Office



Figure 22:Status of Construction of Flood warning site office at Gakiling Haa



Figure 23: Status of Site Office construction at Panbang, Zhemgang



Figure 24: Karmaling Site Office completed

14 CRYOSPHERE MONITORING AND SERVICES

14.1 ANNUAL MONITORING OF BENCHMARK GLACIERS

Throughout the globe, in most of the glacierized alpine and high-altitude regions, glaciers are retreating at an alarming rate that is attributed to the ongoing global climate change (Emmer, 2019). Glacier retreat is connected to various interrelated geomorphological, hydrological processes, and changes in hydrological regimes driven by Climate Change.

Since there is not much data and information on Bhutan glacial regime, the Center has established two long term Benchmark glaciers in Bhutan for annual monitoring, viz., Gangju La glacier in the headwater of Pho Chhu Sub-basin and Thana glacier in the headwater of Chamkhar Chhu Sub-basin.

The Cryosphere Services Division under the NCHM is mandated to carry out annual glacier mass balance studies across the country. In continuation to the past fiscal year, the CSD has conducted glacier mass balance studies on benchmark glaciers. The summaries on glacier mass balance studies are presented below.

14.1.1 GANGJU LA GLACIER

Gangju La Glacier is located in the Northern frontier of Bhutan at 27.940N, 89.950E in the headwater of Pho Chhu Sub-basin with an approximate area of 0.215 km2. This clean ice glacier extends from elevation of 4900 to 5200 m.a.s.l. A team comprising three officials from Cryosphere Services Division (CSD) was deployed to carry out the field activity from September 20, 2020 to November 1, 2020. In the glacio-hydrological year 2020-2021 (Autumn Net Balance), Gangju La Glacier revealed a negative glacier mass loss as the terminus has retreated as well. The detailed methodologies, data processing, results, and recommendations are compiled in the "Scientific Report on Gngju La Glacier 2019-2020".



Figure 25: Cryosphere Field Work Gangjula 2020

14.1.2 THANA GLACIER

Thana Glacier is located in the north-central part of the Bhutan Himalayas in the headwater of Chamkhar Chhu and is oriented Southeast at 28.021°N and 90.607°E (Fig. 3) with a surface area of approximately 3.71 km².

A team comprising five officials from Cryosphere Services Division (CSD) and one official from HWRSD carried out the field activity from September 4, 2020 to September 29, 2020. The detailed methodologies, data processing, results, and recommendations are compiled in the "Mass Balance Status of Glaciers of Bhutan Himalayas-*As observed on Gangjul La and Thana Glacier*".



Figure 26: Cryosphere Field work at Thana glacier 2020

14.2 TIME SERIES MONITORING OF GLACIAL LAKE IN LUNANA AREA.

During the FY 2020-2021, a field expedition was deputed to the head water of Phochhu sub-basin from October 1, 2020 to November 5, 2020. Team conducted a bathymetry survey of lakes and collected other information to assess the potential risks of flood downstream. The detailed methodologies, data processing, results, and recommendations are compiled in the technical report "Time Series Monitoring of Thorthormi glacial lake in the Headwater of Pho-Chhu October 2020-2021".



Figure 27: Cryosphere field work at Thorthormi lake 2020

15 PUBLICATIONS AND REPORTS

The Center is responsible to collect scientific data and carry out research to provide information and services related to hydrology, water resources, meteorology, climatology and cryosphere to line agencies. Based on the field works and research the Centre published numerous reports and guidelines during FY 2020-2021. The reports can be access from Center Website page: www.nchm.gov.bt

The following scientific reports were published and launched during the World Meteorological Day 23 March 2021.

- a. Annual Report the Center for year 2020
- b. Bhutan Glacier Lake Inventory 2021
- c. Bhutan State of the Climate 2020
- d. Hydrograph Separation Using Geochemical and Isotropic Chemistry to Evaluate Glacier Melt Contribution to the Paa Chhu Sub-Basin, Bhutan
- e. Mass Balance Status of Glaciers of Bhutan as Observed on Gangju La and Thana Glaciers



Figure 28: NCHM Technical Publication 2020-2021

16 PROJECT

16.1 VIRTUAL KICK-OFF OF JICA TCP PHASE II

A record of discussion for the Phase II JICA Technical Cooperation Project for Capacity Enhancement of Meteorological Observation, Forecasting and Flood Warning, for Disaster Preparedness and Response in Thimphu and Paro River Basins was signed between GNHC, DDM, NHCM and JICA on 31 October 2019. The project kick off meeting was held virtually on 4 August 2020. The meeting was attended by the Country Representative, JICA Bhutan Office, JICA Experts team from Japan, DDM and NCHM.

The implementation of the project got delayed due to the COVID 19 pandemic as the experts could not come to Bhutan.



Figure 29: JICA Project kick of online meeting August 2021

16.2 GCF PROJECT

The Center is one of the implementation partners of the GCF project "Supporting Climate Resilience and Transformational Change in the Agriculture Sector" started in January 2020. The 5 years project is expected to end by 31 December 2025. Out of the total fund of USD 25.4 million, USD 1.7 million is allocated to NCHM to enhance the climate and agro-met services. Implementation of some of activities got delayed due to the COVID pandemic.

16.3 WMO PROJECT

The project "Developing Capacities for Effective Climate Services in Bhutan" is funded in kind CHF 127,389.00 by Korean Meteorological Agency (KMA) through WMO (2021-2022) The project is implemented by NCHM and RIMES.

16.4 NCHM ICIMOD BRIDGING PROGRAM 2021

ICIMOD allocated USD 50,000.00 (in kind) for NCHM-ICIMOD bridging program to implement following activities for the 2021.

- a. Flash flood forecasting and early warning systems (HIWAT-SPT)
- High Impact Weather Assessment Tool (HIWAT),
- Streamflow Prediction Tool (SPT),
- Training on GIS/Remote Sensing/SERVIR application, statistical and forecast verification
- b. Developing Drought Monitoring System
- c. Capacity building/NCHM Staff Internship at ICIMOD
- Snow Cover Mapping
- Glacier Mass Balance and Surface Mass Balance Models Using R or Python

Internship of NCHM officials at ICIMOD was delayed by the pandemic.

16.5 WORLD BANK PROJECT

The World Bank is supporting the project "Strengthening Risk Information for Disaster Resilience in Bhutan (RIR, P175081, 2021-2023)". The Project is coordinated by the Department of Disaster Management (DDM), MoHCA. The project has allocated USD 651,000.00 for NCHM to implement the following components of the project:

- a. Sub-component- Flood Risk Assessment (USD 471,000.00) of Component A. Development and Piloting of a Multi-hazard Risk Decision Support System;
- b. Component B. Strengthening Hydro-met and Agro-met Services Delivery (USD 180,000.00) to:
 - Develop Hydro-met policy and Hydromet road map of Bhutan;
 - Support to develop technical guidance for the Construction of NWFWC;
 - Medium range weather forecast (Agro-met)

16.6 ESTABLISHMENT OF COMPREHENSIVE FLOOD FORECASTING AND EARLY WARNING SYSTEM FOR AMOCHHU BASIN

Memorandum of Understanding (MOU) between the Construction Development Corporation Limited (CDCL) and the National Center for Hydrology and Meteorology (NCHM) was signed on 14 May 2021 for the establishment of Comprehensive Flood Forecasting and Early Warning System (FFEWS) for Amochhu Basin.

The Druk Holding and Investment (DHI) through the Phuentsholing Township Development Plan (PTDP) implemented by CDLC will support and provide Nu. 28.00 million to the NCHM to implement the FFEWS project (July 2021-June 2023).



Figure 30: MoU Signing between NCHM and CDCL for the establishment of Comprehensive Flood Forecasting and Early Warning System for Amochhu Basin, 14 May 2021

The project is expected to enhance hydro-met disaster preparedness through timely sharing of weather and flood warning services to the new Phuentsholing Township Development area as well as other settlements along the basin. In accordance with the Section 108 of the Disaster Management Act of Bhutan 2013, NCHM is designated as the National Hydro-met Hazard Early Warning Service Provider in the Country.

17 INSTITUTIONAL LINKAGES AND COLLABORATION

17.1 MOU BETWEEN NCHM AND CNR

Coinciding with the World Meteorological Organization (WMO) Day celebration, a Memorandum of Understanding (MoU) between NCHM and College of Natural Resources (CNR), Royal University of Bhutan was signed 23 March 2021 to promote joint collaboration research, exchange of experts and internship.



Figure 31: Signing of MoU between NCHM and CNR, 23 March 2021

17.2 INTERNSHIP FOR STUDENTS

Six final year students (B.Sc in Environmental and Climate Studies and Sustainable Development) from College of Natural Resources (CNR), Royal University of Bhutan joined for a month-long internship in the Center on 19 April 2021.Students were placed in four different divisions and undertook the research work on weather, climate, hydrology and water resources.

Interns presented their works to the Center and a completion certificate were awarded on 21 May 2021.



Figure 32: Certificate awarded to CNR Student for completion of Internship at NCHM, 21 May 2021.

17.3 NCHM PRESENTATION TO PHPA-I AND II

NCHM presented on GLOF hazard and risk from Thorthormi Glacier Lake and associated Glaciers and Status of GLOF EWS to the management of PHPA- I & II, 23 April 2021. The meeting also discussed a wide range of issues particularly on the collaboration required for operation and timely dissemination of GLOF EWS.



Figure 33: NCHM Team with PHPA-I & II Management, 23 April 2021

18 INSTITUTIONAL STRENGTHENING OF HYDRO-MET SECTOR

18.1 HYDRO-MET POLICY FORMULATION

Development of sound hydro-met sciences and services in any country requires appropriate policy and legislation. The Lhengye Zhungtshog approved the concept note to draft the Hydro-met Policy of the Kingdom of Bhutan on 7 August 2020. The Center drafted the Hydro-met Policy of the Kingdom of Bhutan with technical and financial support from the World Bank. The Draft policy was presented to the GB meeting held on 25 June 2021 and will carry out stakeholder consultation during the FY 2021-2022 before submission to GNHC.

18.2 INTERNAL REORGANIZATION OF NCHM PROPOSAL

The Center carried out the organization development exercise with transfer of additional mandates on ambient water quality monitoring from NECS, and streamline functions within the Center for effective utilization of manpower with the following objectives:

- a. To improve the center's capacity/competency to handle its internal and external functioning and relationships;
- b. To ensure proper classification of position titles and categories through harmonization of the position titles;
- c. To ensure clear career progression for existing employees and
- d. To align organization structure with strategy and long-term goals for the effective delivery of services.

A proposal for internal reorganization of NCHM was submitted to RCSC in November 2021.

19 GOVERNING BOARD MEETING

19.1 6th Governing Board Meeting

The 6th Governing Board meeting of the Center was held on 3 December 2020 at Mayto Hotel, Thimphu. The meeting reviewed the Center's plans and programs and endorsed the proposal of internal reorganization of NCHM for onward submission to RCSC which was submitted in November 2021.



19.2 7th GOVERNING BOARD MEETING

The 7th Governing Board Meeting of the Center was held on 25 June 2021. The meeting reviewed the Center's programs and plans progress for the FY 2020-2021 and plans for the FY 2021-2022. The meeting also reviewed and provided comments to the draft of the Hydro-met Policy of the Kingdom of Bhutan (2020.) An Annual Plan Target (APT) for 2020-2021 was signed between Chair and Director.



Figure 35:7th GB Meeting, 25 June 2021

20 REGIONAL AND INTERNATIONAL MEETING

20.1 RIMES 12TH ANNUAL PROGRAM MEETING FROM 1-3 MARCH 2021

On the invitation of the Regional Integrated Multi-Hazard Early Warning System (RIMES), Director of NCHM attended the RIMES 12th Annual Program Meeting from 1-3 March 2021 virtually.

20.2 INTERGOVERNMENTAL PANEL FOR CLIMATE CHANGE (IPCC)

The National Center for Hydrology and Meteorology (NCHM) as the designated National Focal of Bhutan with IPCC attended the following meetings during the FY 2020-2021 with funding from the IPCC Trust.

SI. No	IPCC Meeting	Date	Venue	Year
1	Mr. Phuntsho Namgyel, Chief of Hydro- met Operation and Infrastructure Division attended the Fifty-first Session of the IPCC (IPCC-51) and Second Joint Session of the IPCC Working Groups I & II.	20-23 August 2019	Monaco	2019- 2020
2	Mr. Phuntsho Tshering, Oftg Chief, CSD attended the Fifty-Second Session of the Intergovernmental Panel on Climate Change (IPCC-52)	24-29 February 2020	UNESCO HQ, Paris, France	2019- 2020
3	Mr. Karma Dupchu, Director attended the Fifty-Third Session of the Intergovernmental Panel on Climate Change (IPCC-53)	22-26 March 2021	Virtual	2020- 2021

Table 14: List of IPCC meeting

20.3 24th Meeting of the Meteorology Sub-group (virtual)

NCHM is the designated Aviation Meteorological Service Provider within Bhutan as per the Bhutan Civil Aviation Act of Bhutan and the Center liaise with Bhutan Civil Aviation Authority (BCAA) and International Civil Aviation Organization (ICAO) pertaining to the aviation meteorological services for air navigation. Mr. Sonam Rabten, Sr. Met/Hyd. Officer of the Weather and Climate Services attended the virtual meeting from 16-20 November 2020.

21 IMPORTANT EVENTS

21.1 ORIENTATION PROGRAMME FOR NEW RECRUITS

The Center conducted two days' orientation programme for newly recruited and lateral transfer officials with the objective to induct the candidates into the Civil Service and to integrate and assimilate the candidates as a team player in the organization from 17-18 February 2020.

The officials were briefed about organization structure, organization policies, plans & programmes, BCSR, Financial Rules and their job description in line with the expectations of the Agency.

21.2 NEW DIRECTOR GENERAL, ICIMOD COURTESY VISITED TO CENTER

Dr. Pema Gyamtsho, new Director General, International Center for Integrated Mountain Development (ICIMOD) made a courtesy call to the Director of the Center on 20 October 2020.

The Director on behalf of the Center expressed appreciation to ICIMOD for the support in the areas of cryosphere monitoring, regional flood information system and capacity building of the Center.

Dr. Pema Gyamtsho expressed his appreciation, for the role NCHM is playing and the achievements after it became an autonomous agency. He said that a sustainable funding mechanism needs to be instituted for agencies like NCHM to support generation of scientific information and knowledge that are required by all the sectors and society.

Meeting also discussed future areas of collaboration between NCHM and ICIMOD in:

- a. Long term climate and cryosphere monitoring in Bhutan Himalayas (data gap);
- b. Establish scientific lab for glaciers and related studies in Lunana and
- c. Internship of NCHM young engineers at ICIMOD



Figure 36: Dr. Pema Gyamtsho, new DG, ICIMOD with NCHM Management, 20 October 2020,

21.3 VIRTUAL LAUNCHING OF SOUTH ASIA FLASH FLOOD GUIDANCE SYSTEM (SASIAFFGS), 23RD OCTOBER 2020

The Flash Flood Guidance System (FFGS) of South Asia was developed by the Hydrological Research Center (HRC), USA under the auspices of the World Meteorological Organization (WMO) with funding support from the U.S. Agency for International Development/Bureau for Humanitarian Assistance (USAID/BHA). The project started in 2016 and implemented by WMO in close collaboration with the National Meteorological and Hydrological Services (NMHS) of Bangladesh, Bhutan, India, Nepal and Sri Lanka. The system is being hosted by the Indian Meteorological Department (IMD), India - WMO Regional Center.

The South Asian Flash Flood Guidance System (SAFFGS) was formally launched on 23 October 2020 by Shri Dr. M. Rajeevan, Secretary, Ministry of Earth Sciences, India. The launching was attended by officials from WMO, HRC, the Director General of the collaborating NMHS South Asian and the Permanent Representative (PR) of Bangladesh, Bhutan, India and Sri Lanka with WMO.

The Flash Flood Guidance System (or shortly – FFGS) is a forecaster's tool designed to provide hydrological and meteorological forecasters with readily and accessible quality controlled precipitation estimates from weather radars and satellites, precipitation measurements (rain gauges), forecast data from

Numerical Weather Prediction models, and other information to produce timely and accurate flash flood warnings in South Asia. WMO through the project has supported training and capacity building of NCHM for use of the system as well as dissemination of services.

Bhutan being a mountainous country, highly vulnerable to flash floods, GLOFs, landslides, and windstorms, FFGS will be useful for Disaster Management authorities and local governments to use as a guidance for disaster preparedness and early warning services.

21.4 CIVIL SERVICE AWARD CEREMONY 2020

The Civil Service Award Ceremony for the Center for the year 2020 was held on 12 December 2020 at the Energy conference hall.

The Director NCHM presented the Royal Civil Service Award medals and certificate of appreciation to the four Outstanding Employees of the year 2019-2020 in a simple ceremony. In total 31 staff of the Center received the medals for 10, 20 and 30 years of services and in recognition of their dedicated services to the nation. The details are as given in the table.

Sl No.	10 years (Bronze)	20 Years (Silver)	30 Years (Gold)	Lifetime
1	22	1	4	4



Figure 37: NCHM Civil Servant Award Ceremony 2020

21.5 5th Birth Anniversary of His Royal Highness the Gyalsey

The Center celebrated His Royal Highness the Gyalsey Jigme Namgyel Wangchuck's 5th birth anniversary on 5 March 2021 by thanking all the frontline workers and staff of the Center who has volunteered to work 24/7 in the National Weather and Flood Warning Center (NWFWC), providing uninterrupted delivery of weather and flood warning services during the national lockdown. Promotion orders were handed over to those officials who were promoted in January 2021.



Figure 38: His Royal Highness the Gyalsey 5th Birthday Celebration

21.6 WORLD METEOROLOGICAL DAY 23 MARCH 2021

The Center in partnership with UNDP Bhutan observed WMO Day on 23 March 2021 by organizing a half day "Science Seminar". Honorable Lyonpo Dr. Tandin Dorji, Minister of Foreign Affairs, Royal Government of Bhutan graced the opening session as the Chief Guest. The Seminar was attended by senior officials from the Cabinet, HM's Secretariat, Members of Parliament, line ministries, World Bank, JICA among others.

Coinciding with WMO Day, the Center launched the four scientific reports:

- a. Bhutan State of the Climate 2020
- b. Bhutan Glacial Lake Inventory 2021
- c. Mass Balance Status of Glaciers of Bhutan Himalayas as observed on Gangju La and Thana Glacier.
- d. Hydrograph Separation Using Geochemical and Isotopic Chemistry to Evaluate Glacier Melt Contributions to the Paa Chhu (River), Bhutan.



Figure 39: Hon'ble Chief Guest with Guests during the WMO celebration 23 March 2021

21.7 DEBRIEFING OF SPECIAL DUTY TEAM TO LUNANA, GASA

The Center is responsible for the operation of the Flood Warning Office established at Thanza, Lunana, Gasa after the 1994 GLOF. The Site Office is equipped with HF Wireless and mobile communication. The Flood Warning Office at Thanza, under Gasa Dzongkhag communicates directly with GLOF EWS Control Room, Wangdi, which is operational 24/7. Every year the Center deputes a team of two staff on a special duty to Lunana for a period of one year.

Mr. Ugyen Thinley and Mr. Jigme Lhuendup, Hydro-met Technician volunteered to go on Special Duty at Lunana, Gasa for the FY 2020-2021. Mr. Jigme Lhuendup has volunteered to work there for another one year. They are primarily responsible for physically monitoring glacier lakes of Lunana as a backup to the automatic GLOF EWS. They transmit the data and information to Wangdue Control Room on a sub-daily basis via HF Wireless or mobile.



Figure 40: NCHM Management with Mr. Ugyen Thinley Technician deputed to Lunana

21.8 OBSERVING ZERO WASTE HOUR

Pursuant to the launch of the Zero Waste Hour on 2 June 2019 by Her Majesty the Gyaltsuen, coinciding with the Coronation Day of His Majesty the Fourth Druk Gyalpo, every second day of the month is observed as the Zero Waste Hour. The Center HQ and all the site's offices observes the Zero Waste Hour by cleaning the office surroundings and Hydro-met Station site throughout Bhutan.



Figure 41: NCHM Observe Zero Waste hours every month by clearing respective office

21.9 WORLD BANK RESIDENT REPRESENTATIVE COURTESY VISIT TO NCHM

Dr. Adama Coulibaly, new Resident Representative of World Bank Bhutan office made a courtesy visit to the Center on 4 June 2021. He met with NCHM management and visited the 24/7 National Water and Flood Warning Center (NWFWC). World Bank and NCHM discussed the benefits of the World Bank-supported projects implemented by the Centre and the future potential projects that required financial and technical support from the World Bank for:

- a. Construction of a dedicated NCHM HQ, National Weather and Flood Warning Center (NWFWC) and Scientific facilities;
- b. Strengthening Aviation Meteorological Services for safety of flight operations; and,
- c. Hydrology Project of Bhutan

Mr. Adama appreciated the work and services provided by NCHM and its important role in supporting the World Bank framework of Green, Resilient and Inclusive Development (GRID). He assured the continued support of the World Bank, in strengthening the hydro-met sector in Bhutan towards climate-resilient sustainable development and disaster risk reduction. The World Bank has supported the hydro-met Sector in Bhutan since 1990 in the following areas.

- a. Strengthening of the hydro-meteorological network and data processing procedures under the Bhutan Power System Master Plan (PSMP,1990-1993);
- b. Development of a Road Map for Modernizing Weather, Water, and Climate Services in Bhutan (2014)
- c. Enhancing Information Base for Hydro-met Services and Climate Resilience under the Strategic Program for Climate Resilience (SPCR, 2017-2021);
- d. Enhancing Aviation Meteorological Observation and Services at Paro International Airport, Hydrological and Flood forecasting capacity, and development of agro-met services under the Hydro-met Services and Disaster Resilience Regional (HSDRR, 2017-2021)



Figure 42: World Bank Resident Representative visited NCHM, June 4, 2021

22 HUMAN RESOURCES DEVELOPMENT

22.1 SHORT TERM TRAINING (STT)

Given the travel restrictions during the FY 2020-2021, with the support of international and bilateral partners and projects, employees attended a number of online training courses to enhance the professional capacity and to stay abreast with emerging technology. The Center during the span of one year has processed and facilitated a total of 61 online trainings/meetings/seminars/workshops starting from July 2020 to June 2021.







Among the international partners, the RIMES has provided the maximum support in terms of short-term human resource capacity development for the reporting year 2020-2021 followed by WMO and ICIMOD.



Figure 45: STT by Gender for the FY 2020-2021

From the total of 61 STTs implemented by Center, 73% of the training/seminars/workshops has been availed by the male employees and remaining by female employees for FY 2020-2021. However, when compared to the overall composition of the employees in the Center, there is not much gender disparity in terms of STT in the Center.



Figure 46: NCHM attended the virtual RIMES and WMO meeting
22.2 MANDATORY MEETING/WORKSHOP/CONFERENCE

The NCHM is designated as the national focal point of Bhutan with WMO and IPPC and other Regional organizations. Five officials attended seven mandatory virtual meetings/conference/workshop of IPCC, WMO, ICAO, RIMES and others related to weather, climate and hydrology and cryosphere sciences during the financial year 2020-2021 as delegates.

581	Title of the Morting/Seminar/Conference	Nos. of Delegations	Name of the Delegates	Date	Organiser/ Funding Agency
r	12th RIMES Council Meeting	2	Mr. Kama Dupchi (Director)	25-26	RIMES
			Mr. Tayba Budhha Tamang (Chief Met/Hyd Officer)	November 2020	
2	53rd Session of the IPCC on Electronic and Written Session	2	Mr. Kaena (Specialist III)	7-14 December 2020	IFCC
			Mr. Tayba Badhlia Tamang (Chief Met/Hyd Officer)		
	Part II of the First Session of the Commission of Weather and Related Environment and Application SERCOM-1 (II)	2	Dr. Singay Dorji (Specialist III)	22-26 February 2021	WMO
3			Mr. Tayba Badhha Tamang (Chief Met/Hyd Officer)		
4	Fifty Third (bis) Session of the IPCC (IPCC- 53bis)	1	Mr. Kaenia Dupchii (Director)	22-26 March 2021	IPCC
5	Inception /First Executive Council Meeting	1	Mr. Kama Dupchu (Director)	01 April 2021	RIMES
	Part III of the First Session of he Commission for Observation, Infrastructure and Information Systems, IMFCOM-1 (III)	2	Mr. Tayba Badhira Tamang (Chief Met/Hyd Officer)	12-16 April 2021	wмo
0			Mr. Pashupati Sharma (Principal Engineer)		
7	Seventeenth Session of the Regional Association II (Asia) RA II-17	1	Mr. Kama Dupchu (Director)	25-26 May 2021	WMO.

Table 15: List of Important Virtual Meetings/Workshops/Conference attended in the FY 2020-2021

22.3 LONG TERM STUDY

During this year, the Center has processed three long term studies under JDS and Nehru Wangchuck Scholarship as detailed in table;

Sl#	Name/P Title	Course	Institute /Country	Funding
1	Ms. Pema Syldon (Met/Hyd. Officer)	Masters in Counter Measures for Climate Change and Disaster Risk Management	Nagoya University, Japan	JDS

 Table 16: List of long-term trainings processed for FY 2020-2021

2	Mr. Jamyang Zangpo (Engineer)	Master in Flood Disaster Risk Reduction	National Graduate Institute for Policy Studies, Japan.	JDS
3	Mr. Trashi Namgyel (Executive Engineer)	Masters of Technology (Water Resources and Development)	Indian Institute of Technology Roorkee (India)	Nehru Wangchuck Scholarship

Currently, a total of five employees including the above three officials are on study leave pursuing master's degree and Bachelor's degree under various scholarships.

23 WELLBEING OF STAFF

23.1 POTLUCK LUNCH

To promote solidarity and interaction among the staff, the Center has initiated Potluck lunch every last Friday of the month, however, it has to be temporarily discontinued after COVID19 pandemic from July 2020.

23.2 NCHM STAFF WELFARE FUND

To strengthen solidarity among the staff and provide financial support in times of need, the Center established a Staff Welfare Scheme in 2017 with monthly contributions from the members. The membership is open to all the staff of NCHM on a voluntary basis. The Welfare Scheme is managed by the Committee nominated from the members during the Annual General meeting.

24 CHALLENGES AND ISSUES

Being a new autonomous agency entrusted with technical and scientific mandates, the Center is facing a number of challenges from financial, human resources, office space to technical and scientific facilities. The following are the key issues and challenges that need immediate interventions.

- a. Lack of office space and scientific facilities
- b. No Hydromet Policy and related legislation
- c. Nature of job and 24/7 functions
- d. Limited trained technical professional for effective delivery of hydromet services.

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