



# Hydro met Policy of the Kingdom of Bhutan 2023

Royal Government of Bhutan

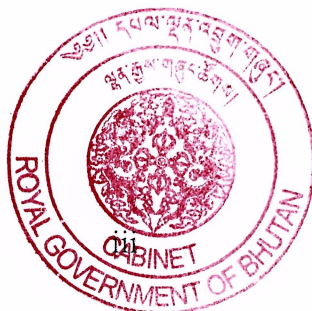
*(September 2023)*





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## 1. Policy title

This Policy shall be called the “Hydro-met Policy of the Kingdom of Bhutan 2023” and come into effect from the day of the approval by the Cabinet and remain in force until amended or superseded.

## 2. Rationale

Bhutan’s economy is highly dependent on climate-sensitive sectors such as agriculture, hydropower, and forestry. Climate change will have long term impacts on the economy and the sustainable development goals. The most significant impact of climate change in Bhutan is the formation of supra-glacial lakes due to the accelerated retreat of glaciers with increasing temperatures. This will have a huge impact on national water security and risk of downstream flooding. Bhutan is also highly prone to a range of hydro-meteorological hazards, including flash floods, riverine floods, landslides, landslide dam outburst floods, cloudbursts, windstorms, and other extreme weather events. Climate change is mainstreamed into development plans and programs and strengthening climate resilience and addressing hydro-meteorological hazards are identified as priority issues. Climate science has become important for policy and planning of adaptation and mitigation strategies to support socio-economic development.

The Royal Government of Bhutan has created the National Center for Hydrology and Meteorology (NCHM) as an autonomous, technical, and scientific agency in 2016 based on the Organization Development (OD) Exercise of the RCSC, subsequently approved by the Cabinet during its 92nd Lhyengye Zhungtshog held on 11<sup>th</sup> December 2015. NCHM is mandated for observation, management and collaboration, research, modeling, and prediction to provide services on hydrology, meteorology, cryosphere, and climate change to make development plans, and prepare for, mitigate, and respond to natural and extreme hydro-met events

NCHM aspires to advance scientific research and technical capabilities to support development and better meet the needs of the society. There is no legislation or policy that governs and regulates development and operations of hydro met sciences and services facing following issues.

- i. Multiple agencies have set up hydro-meteorological observation stations and collected data without adherence to measurement standards leading to duplication, and poor coordination among stakeholders often leading to poor accountability.



- ii. Displacement of observation stations and hydro met infrastructure located within the premises of other agencies compromising quality and long-term time series data collection.
- iii. Lack of framework or guidelines for standardization of hydro-met instrument and quality management system (QMS) hampering quality of data, data exchange and effective service delivery.
- iv. There is no established protocol for engagement and monitoring of research activities on hydrology, meteorology, and cryosphere sciences in Bhutan
- v. There are no guidelines to engage and regulate emerging private hydro-met service providers.
- vi. Currently hydro-met data and services are provided free of cost and there is no mechanism to charge for data and services. A mechanism needs to be established to charge for the specialized and tailor-made data and services to support sustenance of observation networks and facilities.
- vii. No guidelines for exchange and dissemination of hydro-met data and information which compromises accuracy and timely dissemination
- viii. Challenges in complying with the International Civil Aviation Organization (ICAO) and World Meteorological Organization (WMO) regulations as there is no policy guidance for compliance with international standards and agreements. To address these existing and the emerging challenges, a dedicated hydro-met policy is required.

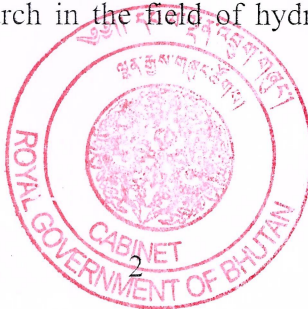
## 2.1 Vision

Building a well prepared and responsive nation to hydro meteorological threats and opportunities through access to high quality and accurate meteorology, climate, cryosphere, and hydrological information

## 2.2 Policy objectives

This policy shall be the guiding document for the development, enhancement, and provision of services on meteorology, hydrology, cryosphere in the Kingdom of Bhutan.

- i. To strengthen institutional mandate and governance for development and provision of hydro met services
- ii. To enhance quality of hydromet services for socio-economic development, disaster risk reduction, protection of lives and properties
- iii. To promote scientific research in the field of hydrology, meteorology, cryosphere sciences and its application



### 3 Policy statements

To achieve the vision and objectives of the Hydro-met Policy of the Kingdom of Bhutan, policy statements are framed and formulated in the following thematic areas.

#### 3.1 Institutional mandate and governance

Climate Change Policy of the Kingdom of Bhutan (2020) mandates NCHM to provide national sources of hydro-meteorological data, service, and advice to meet the needs of the general public, emergency services and other specialized users; and to provide hydro-meteorological data and information, climate modeling and scenarios and other early warning services. In accordance with Section 108 of the Disaster Management Act of Bhutan 2013, NCHM is designated as the Hydro-met Hazard Early Warning Service Provider in the country to ensure early warning system for identifying Hydro-met hazards and to notify all vulnerable populations and responding agencies of the threatening disaster situation or disaster in the country vide Government Order no.C-2/2019/369 dated December 05, 2019 issued by the Hon'ble Prime Minister of Bhutan. Bhutan Civil Aviation Authority (BCAA) has designated NCHM as the National Aeronautical Meteorological Service Provider (AMSP) within Bhutan, the latest certificate of designation is BCAA/ANS-D&N/27/002 dated May 03, 2018 to provide air navigation services. There is a need for dedicated policy to harmonize existing policy provisions and strengthen governance and improve service delivery.

#### Policy statements

*The Royal Government of Bhutan (RGoB) shall strengthen NCHM governance and institutional set-up through development of legislations or regulatory frameworks for hydro-met science and services; and provide adequate resources and manpower including skills enhancement and up gradation.*

- 3.1.1 NCHM shall be the nodal agency of the Royal Government of Bhutan for hydrology, meteorology, climate change and cryosphere sciences and services;
- 3.1.2 NCHM shall establish and operate national hydro-met observation network and communication systems for monitoring and collection of hydromet data;
- 3.1.3 NCHM shall provide aviation meteorological services
- 3.1.4 NCHM shall develop and deliver timely, accurate, and reliable hydromet information and services
- 3.1.5 NCHM shall provide Public Weather Service (PWS)
- 3.1.6 NCHM shall provide climate change projection services
- 3.1.7 NCHM shall provide early warning services for disaster risk reduction
- 3.1.8 NCHM shall establish and operate national hydro-met data management and decision support systems



- 3.1.9 NCHM shall carry out scientific research and development on hydromet Sciences
- 3.1.10 NCHM shall adopt and promote relevant standards for measurement, method of collection and instrumentation.
- 3.1.11 NCHM shall operate 24/7 National Weather and Flood Warning Center (NWFWC) and River Basin Flood Monitoring and Warning Centers

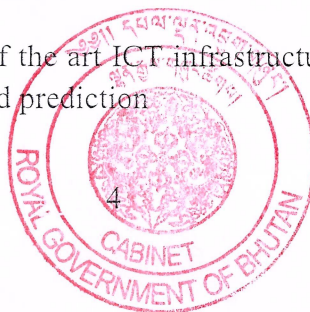
### **3.2 Hydromet Infrastructure**

The Hydro-met Observation networks and infrastructure includes meteorological stations, hydrological stations, communication system, GLOF Early Warning Systems (EWS), Flood EWS Control Rooms, Siren towers, calibration and sediment lab, weather radar, National Weather and Flood Warning Center (NWFWC) to generate and exchange basic surface-based observational data critical for improved weather forecasts and climate services as well as the issuance of warnings and advisories. Adequate resources are required for development, modernization, and sustenance of hydromet infrastructure to ensure high quality and timely hydromet information.

#### **Policy Statement**

*The Royal Government of Bhutan shall develop, modernize, and maintain sustainable operation of hydro-met observation stations, communication networks and other infrastructure facilities to ensure effective delivery of services.*

- 3.2.1 RGoB shall provide adequate resources for establishment, operation, and maintenance of hydromet stations, ICT systems and related infrastructure
- 3.2.2 RGoB shall ensure sustainable investment in strengthening and modernizing hydro-met observations, early warning systems and scientific facilities.
- 3.2.3 RGoB shall allocate appropriate land for installation of hydromet stations and infrastructure.
- 3.2.4 RGoB shall facilitate and promote use of Global Communication Systems such GTS;
- 3.2.5 RGoB shall ensure access to redundant communication such as satellite communication systems for monitoring and delivery of effective flood and GLOF early warning services.
- 3.2.6 Line ministries and agencies shall facilitate operation of hydro-met network and data collection
- 3.2.7 NCHM shall establish and operate Early Warning Systems for weather, floods and GLOF
- 3.2.8 NCHM shall establish and operate hydromet instrument calibration laboratories and testing facilities
- 3.2.9 NCHM shall establish state of the art ICT infrastructure and computing systems for data processing, modeling, and prediction



- 3.2.10 Telecommunication operators shall ensure uninterrupted connectivity to support collection and dissemination of hydromet information and warnings.
- 3.2.11 NCHM shall collect minimal fees for use of scientific equipment and facilities

### **3.3 Data Management, Exchange, and Information Dissemination**

Data management is essential in weather and climate research as it enables the collection, storage, and analysis of vast amounts of data from various sources. Proper data management improves the accuracy of weather and climate predictions, identifies knowledge gaps, and aids in more focused research efforts. Data exchange and dissemination are also crucial as they enable collaboration and the sharing of findings among researchers and stakeholders. Disseminating data to the public, policymakers, and other stakeholders is essential for informed decision-making, planning, and preparedness for extreme weather events. Effective data management, exchange, and dissemination are critical for advancing our understanding of weather and climate patterns and mitigating the impacts of extreme weather events.

#### **Policy Statements:**

*The Royal Government of Bhutan shall develop appropriate and adequate data management and archival systems to enhance data quality, data security and promote data exchange and dissemination of information.*

- 3.3.1 RGoB shall establish and operate National Hydromet Data Center with state-of-the-art data management systems and computing facilities
- 3.3.2 RGoB shall allow exchange of hydro-met data with national, regional, and international partners in accordance with relevant regulations and agreements
- 3.3.3 NCHM shall be the ultimate source of hydromet data
- 3.3.4 NCHM shall ensure adequate data security and protection systems
- 3.3.5 NCHM shall ensure adequate data quality control systems
- 3.3.6 NCHM shall collect administrative fee for selected hydromet data and services
- 3.3.7 NCHM shall collect service charge for aviation meteorological services
- 3.3.8 NCHM shall use mainstream and social media channels for service delivery
- 3.3.9 Stakeholders shall facilitate and collaborate in with national, regional, and international partners in dissemination of the weather and flood/GLOF early warning services

### **3.4 Hydrological, Meteorological and Cryosphere Services**

Weather and climate information services help individuals and organizations to make climate smart decisions. Climate services equip decision makers in climate-sensitive sectors with



better information to help society adapt to climate variability and change. It includes seasonal forecasting, and public weather services (PWS).

Understanding of Hydrology and Water Resources is very important for the effective use of hydrology in sustainable development to reduce the risk and impacts of water-related disasters and to support effective environmental management. Similarly, the Glaciers are an indicator of climate change. It is the main source and reservoir of water resources for Bhutan. Cryosphere conditions significantly influences the water resource availability and weather affecting, safety of life, economic development, and management of important mountain resources. Past and present Cryosphere information is necessary to enable better understanding of water resources management and associated hazard and risk downstream.

### **Policy statements**

*The NCHM shall develop and provide reliable, accurate, and efficient weather and climate services including the following but not limited to;*

#### **3.4.1 Weather and Climate Services**

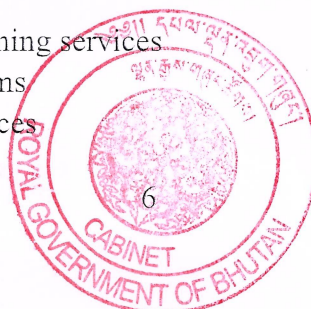
- i. Short range and long-range weather forecast services
- ii. Weather advisories and warnings
- iii. Climate data and analysis services
- iv. Climate monitoring and prediction services
- v. Air quality monitoring services
- vi. Agrometeorological services
- vii. Aviation meteorological services
- viii. Climate change projection and information services
- ix. Weather Modeling and prediction services

#### **3.4.2 Hydrology and Cryosphere Services**

- i. Hydrological and cryosphere data and analysis services
- ii. Flood and flow forecasting services
- iii. Snow and glacier monitoring services
- iv. Glacial lake monitoring services
- v. Risk and hazard mapping services
- vi. Hydrological modeling and prediction services
- vii. Ambient Water quality monitoring services

#### **3.4.3 Early warning services**

- i. Extreme weather early warning services
- ii. GLOF early warning systems
- iii. Flood Early Warning Services



### 3.5 Standards and Quality Management

Adopting standards and a quality management system is crucial in providing hydrology and meteorology services as it ensures the accuracy, consistency, and reliability of the information provided to stakeholders. Standards provide a framework for quality management, allowing for a more systematic and standardized approach to data collection, analysis, and reporting. A quality management system ensures that processes are in place to continuously monitor and improve service quality, leading to better decision-making and more effective preparedness for extreme weather events. Adopting standards and a quality management system also enhances transparency and accountability, increasing stakeholder trust and confidence in the services provided. Hence, adopting standards and a quality management system is essential for providing high-quality hydrology and meteorology services that meet stakeholder needs and expectations.

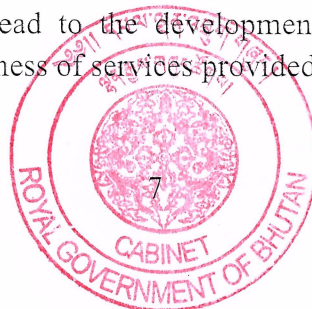
#### Policy Statements:

*The RGoB shall ensure adoption of standard hydro-met observation methods, instruments, and data collection methods in compliance with the known international and national standards to ensure quality data and services.*

- 3.5.1 NCHM shall adopt Quality Management System for hydromet services
- 3.5.2 NCHM shall adopt and implement WMO guidelines on data collection, management, quality assurance, quality control, and data processing
- 3.5.3 NCHM shall develop, and promote standardization of hydro-met instruments and methods of data collection.
- 3.5.4 NCHM shall adopt WMO guidelines for hydromet instruments and systems
- 3.5.5 NCHM shall adopt and implement WMO guidelines for Common Alert Protocol (CAP) for dissemination of warnings and advisories.

### 3.6 Research and Development

Research and development in hydrology, meteorology, and climate sciences and services is crucial for advancing our understanding of weather and climate patterns and for improving the accuracy of predictions. Research can lead to the development of new technologies and approaches to data collection and analysis, resulting in more accurate and reliable weather and climate predictions. Research also helps to identify emerging trends and patterns in weather and climate, informing decision-making and preparedness efforts. In addition, research and development can lead to the development of new services and products, increasing the range and effectiveness of services provided. Ultimately, investing in research



and development is critical for improving hydrology, meteorology, and climate services and for mitigating the impacts of extreme weather events.

**Policy Statements:**

*The Royal Government of Bhutan shall promote research and development to enhance knowledge and understanding of science in hydrology, meteorology and Cryosphere and its applications.*

- 3.6.1 RGoB shall ensure adequate financial resources for necessary infrastructure and capacity building to carry out research and development activities
- 3.6.2 NCHM shall conduct and promote research on hydromet sciences and services
- 3.6.3 NCHM shall conduct research on hydromet modeling and prediction
- 3.6.4 NCHM shall support research activities and facilitate transfer of knowledge and technologies
- 3.6.5 NCHM shall collaborate with research institutions within and outside the country
- 3.6.6 NCHM shall promote and establish research facilities for modeling and prediction
- 3.6.7 NCHM shall develop research protocol and guidelines on hydromet research

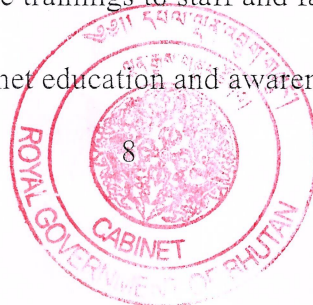
**3.7 Capacity Development, Education, and Training**

Capacity development for hydrology and meteorology service providers is essential as it enhances their ability to provide high-quality services that meet stakeholder needs and expectations. Capacity development can include training, education, and the acquisition of new skills and knowledge, enabling providers to better collect, process, and analyze data. Improved capacity leads to more accurate and reliable weather and climate predictions, better decision-making, and more effective preparedness for extreme weather events. Capacity development also helps service providers stay up-to-date with advances in technology and new approaches to service delivery. Ultimately, investing in capacity development for hydrology and meteorology service providers is critical for ensuring the provision of high-quality services that are essential for protecting lives, property, and the environment.

**Policy Statements:**

*The Royal Government of Bhutan shall support capacity development through education and training to abreast with changing technology and science.*

- 3.7.1 NCHM shall develop professional competencies of hydromet personnel
- 3.7.2 NCHM shall develop and design training resources for hydromet sciences
- 3.7.3 NCHM shall provide periodic trainings to staff and facilitate continuous professional development
- 3.7.4 NCHM shall conduct hydromet education and awareness programs for stakeholders



- 3.7.5 NCHM shall establish and operate dedicated training center with adequate training infrastructure and resources
- 3.7.6 NCHM shall foster collaboration with relevant colleges, universities, and training institutions in the field of hydromet science
- 3.7.7 NCHM shall provide expert services on hydromet science, data, and technologies
- 3.7.8 NCHM shall collect administrative fees for use of training facilities and expert services

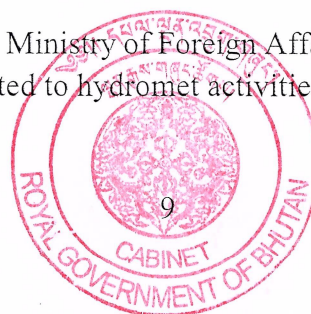
### **3.8 Partnership and Collaboration**

Collaboration and partnership are essential for providing high-quality weather, climate, and hydrological services at national, regional, and international levels. Collaborating with other organizations and stakeholders enables the sharing of data, expertise, and resources, leading to more accurate and comprehensive weather and climate predictions. Partnerships also facilitate capacity development and technology transfer, enhancing the ability of service providers to deliver high-quality services. Collaborating across borders also improves the coordination of preparedness and response efforts, increasing the effectiveness of services provided. Ultimately, collaboration and partnership are essential for ensuring the provision of reliable and effective weather, climate, and hydrological services that protect lives, property, and the environment

*The RGoB shall ensure partnership with national, regional, and international stakeholders for enhancement and utilization of hydro-met technology, knowledge, and data exchange.*

#### **Policy Statements:**

- 3.8.1 RGoB shall support and promote cooperation with regional and international organizations to which Bhutan is signatory.
- 3.8.2 RGoB shall facilitate appropriate partnership mechanisms such as conventions, Memorandum of Understandings (MoUs), forums, networks, and associations
- 3.8.3 NCHM shall be the designated national focal point of Bhutan with the World Meteorological Organization (WMO)
- 3.8.4 NCHM shall be the focal point of Bhutan with the Intergovernmental Panel on Climate Change (IPCC).
- 3.8.5 The Head of NCHM shall be the Permanent Representative (PR) of Bhutan with WMO.
- 3.8.6 NCHM shall foster partnerships with relevant national, regional, and international partners for use, exchange, and dissemination of hydromet information, trainings, and capacity development
- 3.8.7 NCHM shall liaise with the Ministry of Foreign Affairs and External Trade for bilateral and multilateral affairs related to hydromet activities



#### **4 Legislative Compliance**

This policy is compliant to and compliment following legislations. The detailed analysis is attached as *Annexure I*.

- i. The Constitution of the Kingdom of Bhutan
- ii. Climate Change policy of Kingdom of Bhutan 2020
- iii. Water Act Bhutan 2011
- iv. Disaster Management Act of Bhutan 2013
- v. Civil Aviation Act of Bhutan 2016
- vi. National Environment Protection Act 2011

#### **5 Implementation Procedure**

NCHM shall be the custodian of this Policy. NCHM as the National Centre will have a functional autonomy. The Head/Director of the Centre will report to the Secretary, Ministry of Energy and Natural Resources based-on relevance and synergies of functions. The oversight on administration, strategic policy and governance of the Centre will be guided by the Secretary, Ministry of Energy and Natural Resources (MoENR). In order to implement this Policy, NCHM will work in partnership with stakeholders at all levels to develop policy action plans to achieve the objectives of the policy.

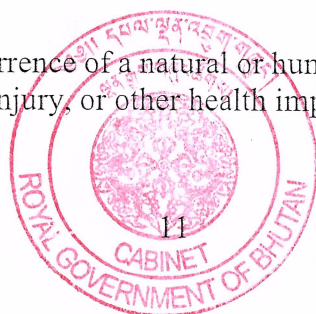
#### **6 Monitoring and Evaluation**

- 6.1 NCHM shall develop policy action plan, guidelines, SOPs, rules, and regulations
- 6.2 Appropriate agency shall approve rules and regulations
- 6.3 The policy shall be integrated into FYPs and annual work plans
- 6.4 The office of the Cabinet Affairs and Strategic Coordination in consultation with NCHM shall;
  - i. Monitor the implementation of the policy action plan
  - ii. Review or amend the policy after five years from the start of commencement of the policy



## 7 Definitions

- i. **Agrometeorological Services:** All agrometeorological and agro-climatological information that can be directly applied to try to improve and/or protect the livelihood of farmers in agricultural production may be considered to belong to agrometeorological services.
- ii. **Aviation Meteorological Service Provider:** The designated Authority of a State to provide or to arrange for the provision of meteorological services for international air navigation as required under Chicago Convention.
- iii. **Aviation Meteorological Services:** Services designated to provide the meteorological information required for air navigation.
- iv. **Common Alerting Protocol:** The Common Alerting Protocol (CAP) is a digital format for exchanging emergency alerts, allows a consistent alert message to be disseminated simultaneously over multiple communications pathways for public safety
- v. **Climate:** In a narrow sense climate is usually defined as the average weather -or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities- over a period ranging from months to thousands or millions of years.
- vi. **Climate Change:** A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer.
- vii. **Climate Services:** Information and products that enhance users' knowledge and understanding about the impacts of climate change and/or climate variability so as to aid decision-making of individuals and organizations and enable preparedness and early climate change action.
- viii. **Cryosphere:** The components of the Earth System at and below the land and ocean surface that are frozen, including snow cover, glaciers, ice sheets, ice shelves, icebergs, sea ice, lake ice, river ice, permafrost, and seasonally frozen ground.
- ix. **Early Warning Systems (EWS):** The set of technical and institutional capacities to forecast, predict, and communicate timely and meaningful warning information to enable individuals, communities, managed ecosystems, and organizations threatened by a hazard to prepare to act promptly and appropriately to reduce the possibility of harm or loss.
- x. **Glacier:** A perennial mass of ice, and possibly firm and snow, originating on the land surface by accumulation and compaction of snow and showing evidence of past or present flow.
- xi. **Hazard:** The potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to



property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources.

- xii. **Hydrology:** Science that deals with the waters of the earth: their occurrence, circulation, and distribution, their chemical and physical properties and their reaction with the environment including their relations to living things, thus addresses both the hydrologic cycle and water resources.
  - xiii. **Hydro-meteorology/hydromet:** Includes the science of hydrology, meteorology and cryosphere.
  - xiv. **Hydro-met Data:** includes meteorology, hydrology, cryosphere and related environmental data.
  - xv. **Hydro-met Services:** including all the services related to meteorology, hydrology and cryosphere science and its applications.
- XVI. Quality Management System:** A quality management system is a set of interrelated or interacting elements that organizations use to direct and control how quality policies are implemented and quality objectives are achieved.
- xvii. **Hydro-met Service Provider:** Agency or organization designated by the Government as the National Authority for observations, research, modeling, and prediction to provide services related to meteorology, hydrology, and cryosphere.
  - xviii. **Meteorology:** A science that deals with the atmosphere and its phenomena with a major focus on weather forecasting.
  - xix. **Weather Forecasting:** Weather forecasting is the application of science and technology to predict the conditions of the atmosphere for a given location and time.
  - xx. **National Meteorological and Hydrological Service (NMHS):** The National Authority responsible for providing meteorological, hydrological, and related services in the country.
  - xxi. **Hydromet infrastructure:** Includes observation network, communication, ICT, Offices, control rooms.
  - xxii. **Hydromet services:** Services on meteorology, hydrology, climate change, Cryosphere and include aviation meteorology

