SOUTH ASIA HYDROMET FORUM

CLIMATE SERVICES WORKSHOP

Working Group Inception Meeting
and Technical Training on the Application of Seasonal
and Sub-Seasonal Forecasts

24-26 JUNE 2025 | BANGKOK, THAILAND

EVENT SUMMARY REPORT

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ACRONYMS

ADPC: Asian Disaster Preparedness Center

ADVISE: Agro-meteorological Advisory System

AI: Artificial Intelligence

AMD: Afghanistan Meteorological Department

APCC: APEC Climate Center

APEN: Asia-Pacific Economic Cooperation Network

APIs: Application Programming Interfaces

ARRCC: Asia Regional Resilience to a Changing Climate

ASEAN: Association of Southeast Asian Nations

BMD: Bangladesh Meteorological Department

BoM: Bureau of Meteorology (Australia)

CARA: Climate Action for a Resilient Asia

CMIP: Coupled Model Intercomparison Project

CPT: Climate Predictability Tool

CS WG: Climate Services Working Group

CSUF: Climate Services User Forums

DGHS: Directorate General of Health Services

DMH: Department of Meteorology and Hydrology (Myanmar)

DoM: Department of Meteorology (Sri Lanka)

DSS: Decision Support System

ECMWF: European Centre for Medium-Range Weather Forecasts

ENSO: El Niño-Southern Oscillation

ERA5: ECMWF Reanalysis 5

ESCAP: UN Economic and Social Commission for Asia and the Pacific

FAO: Food and Agriculture Organization

FCDO: Foreign, Commonwealth and Development Office (UK)

GCF: Green Climate Fund

GFCS: Global Framework for Climate Services

GIS: Geographic Information System

GIZ: German Agency for International Cooperation

GPCs: Global Producing Centers

HMI: Humanitarian Mutual Information

IBF: Impact-Based Forecasting

ICIMOD: International Centre for Integrated Mountain Development

IITM: Indian Institute of Tropical Meteorology

IMD: India Meteorological Department

INGO: International Non-Governmental Organization

IOD: Indian Ocean Dipole

IRI: International Research Institute for Climate and Society

IT: Information Technology

IWMI: International Water Management Institute

JMA: Japan Meteorological Agency

JJAS: June-July-August-September

KVKs: Krishi Vigyan Kendras (Farm Science Centers)

MAAW: Ministry of Agriculture and Animal Welfare (Maldives)

MMS: Maldives Meteorological Service

MoU: Memorandum of Understanding

NASA: National Aeronautics and Space Administration

NBRO: National Building Research Organisation (Sri Lanka)

NCHM: National Centre for Hydrology and Meteorology (Bhutan)

NCEP: National Centers for Environmental Prediction

NCOF: National Climate Outlook Forum

NCMRWF: National Centre for Medium Range Weather Forecasting

NDMA: National Disaster Management Authority

NFCS: National Framework for Climate Services

NMHS: National Meteorological and Hydrological Services

NWP: Numerical Weather Prediction

PMD: Pakistan Meteorological Department

RA5: WMO Regional Association V (South-West Pacific)

RCC Pune: Regional Climate Centre Pune

RCP: Representative Concentration Pathway

RDAS: Regional Data Analytics System

RFCS: Regional Framework for Climate Services

RIMES: Regional Integrated Multi-Hazard Early Warning System for Africa and Asia

SASCOF: South Asia Climate Outlook Forum

SAHF: South Asia Hydromet Forum

S2S: Seasonal to Sub-seasonal (forecasts)

SPI: Standardized Precipitation Index

SSF: Sub-Seasonal Forecast

THI: Temperature Humidity Index

ToR: Terms of Reference

UNCCD: United Nations Convention to Combat Desertification

WFP: World Food Programme

WMO: World Meteorological Organization

WRF: Weather Research and Forecasting

XCAST: Open-source software for forecast analysis

EXECUTIVE SUMMARY

In May 2025, the South Asia Hydromet Forum Executive Council (SAHF EC) endorsed the Climate Services Working Group (CS WG) as a new regional platform to strengthen the delivery and application of climate services. The inaugural SAHF CS WG workshop launched the group, established its governance structure and membership, and initiated development of a comprehensive work plan aimed at enhancing climate services across South Asia.

The workshop emphasized a collaborative and integrated approach, necessitating strong involvement from NMHSs, diverse user sectors, and international partners. The thematic priorities identified in the SAHF Climate Services Workshop in January 2025 aided the focus for the inception meeting of the new CS WG which were: strengthening regional coordination, improving climate data access and standardization, enhancing stakeholder engagement and capacity development, securing resource mobilization and long-term sustainability, and establishing robust monitoring, evaluation, and implementation mechanisms.

The workshop largely met its targeted objectives and outcomes:

- **Formal establishment of the CS WG with endorsed ToR and elected leadership:** Dr. OP Sreejith (IMD, India) and Dr. Quamrul Hassan (BMD, Bangladesh) were appointed as co-chairs, and the WG governance structure was discussed.

- **Draft regional CS WG work plan aligned to SAHF EC themes:** Based on the thematic priorities, a comprehensive draft work plan was presented and organized into the following key themes: Regional Framework for Climate Services (RFCS), Data Use, Access, and Sharing, Capacity Enhancement & Capability Building, Development of Tools and Decision Support Systems, User Engagement, and Enabling Policy and Institutionalisation. This draft is to be finalized and presented to the SAHF Executive Council by September 2025.

- **Enhanced technical capacity of NMHSs and user sectors to generate and apply S2S forecasts:** Country presentations highlighted existing capacities and identified significant gaps, leading to detailed discussions on training needs, tool development, and methodologies for S2S forecast application and interpretation.

- **Established partnerships and technical networks to support sustained regional cooperation and knowledge exchange:** The workshop itself fostered collaboration among NMHSs, user sectors, and development partners like RIMES, UK Met Office, WMO, WFP, ADPC, ESCAP, and CORDEX, setting the stage for ongoing cooperation and knowledge sharing. Discussions on leveraging existing and emerging initiatives (e.g., WISER Asia-Pacific, CREWS South Asia, heat health networks) underscored opportunities for sustained support.

Immediate next steps for the SAHF CS WG include refining the work plan to incorporate detailed feedback from the stakeholders and partners while ensuring alignment with national initiatives and international frameworks. Continuous dialogues and regular updates with stakeholders will maintain the momentum of the CS WG and will be crucial for sustained alignment. Activities will be prioritized based on realistic resourcing and funding opportunities from partners.

I. INTRODUCTION

The South Asian region is highly vulnerable to the intensifying impacts of extreme weather events and climate change, profoundly affecting key sectors such as agriculture, food security, water resources, health, disaster mitigation, and energy, which necessitates comprehensive climate services.

The foundation of effective climate services lies in robust forecasting, starting from extended-range forecasts, specifically seasonal to sub-seasonal (S2S) and monthly forecasts. Under WMO guidance, there is now digital access to grand global ensemble forecasts from 12 to 15 models, including those from North America and Europe's Copernicus. Eight to nine global centers are generating S2S scale forecasts, which provide temperature and rainfall anomalies that are increasingly bias-corrected. These digital products offer significant opportunities to customize forecast applications based on the specific needs of Asian sectoral groups.

Each country within the region possesses unique user-sector specific needs, influenced by varying operating patterns, local climate-impacted health emergencies (from heatwaves to heavy rainfall), and evolving air quality issues under climate change. These cascading and compounding impacts necessitate comprehensive climate services. The variability observed at medium and short ranges is signaled by the temperature and rainfall anomalies generated through S2S forecasts, which should serve as the starting point for climate services and engagement with user groups to build associated services.

In response, the South Asia Hydromet Forum (SAHF) has emerged as a key platform to strengthen regional collaboration on hydrometeorological services. SAHF fosters cooperation among NMHSs, policymakers, and technical institutions, aiming to improve the generation, delivery, and application of climate and weather information across South Asia.

To advance this mission, SAHF has established the Climate Services Working Group (CS WG) – a regional mechanism to enhance cross-border coordination, harmonize data practices, and co-develop climate services that are demand-driven and tailored to user needs. The CS WG is envisioned as a strategic mechanism to link national priorities with regional and global frameworks such as the Global Framework for Climate Services (GFCS), South Asia Climate Outlook Forum (SASCOF), Climate Services User Forums (CSUF), and national monsoon forums- paving the way toward a Regional Framework for Climate Services (RFCS).

Scoping discussions and broader stakeholder consultations-including outcomes from the Planning Workshop on IBF and CS held in January 2025- have identified five core thematic priorities to guide the SAHF CS WG's work: enhancing regional coordination; improving climate data access and standardization; strengthening stakeholder engagement and capacity development; securing resource mobilization and long-term sustainability; and establishing robust monitoring, evaluation, and implementation mechanisms. These themes will shape the structure of WG discussions and form the foundation of the CS WG's regional workplan.

The inaugural session of the CS WG defined the priorities for the new climate services working group and established its governance mechanism, discussed vulnerabilities of the South Asia region to climate change and possible solutions through collaboration among various sectoral representatives. Over the course of three days, participants assessed current capacities and identified gaps in climate services, alongside training and capacity-building activities centered on seasonal and sub-seasonal forecasting and climate change projections.

This workshop was made possible through the World Bank-supported Climate Adaptation and Resilience for South Asia (CARE) project, with support from the UK Met Office through the

Weather and Climate Information Services (WISER) Component of the Climate Action for a Resilient Asia (CARA) Programme.

II. WORKSHOP OBJECTIVES

By bringing together NMHSs, sectoral agencies, technical experts, and development partners, the SAHF Climate Services Workshop had the following objectives:

a. Establish the SAHF CS WG, including governance structure and membership, and appoint Co-chairs.
b. Define a regional CS workplan aligned with global and regional frameworks.
c. Strengthen technical capacity of NMHSs and sector stakeholders to use seasonal and sub-seasonal forecasts effectively.
d. Promote institutional coordination between forecast providers and user agencies.
e. Explore areas to co-develop tools, methodologies, and guidance for sector-specific climate services.

III. EXPECTED OUTCOMES

The workshop aimed to achieve the following outcomes:

- Formally establish the CS WG with endorsed ToR and elected leadership;
- Draft regional CS WG workplan aligned to SAHF EC themes, to be finalized and presented to the SAHF Executive Council by September 2025;
- Enhanced technical capacity of NMHSs and user sectors to generate and apply S2S forecasts;
- Established partnerships and technical networks to support sustained regional cooperation and knowledge exchange.

IV. SESSION HIGHLIGHTS

IV.1 Session 1: Establishing the Climate Services Working Group

2.1 WG Governance

The discussion focused on the Climate Services Working Group's formation based on its Terms of Reference (ToR), as endorsed by the SAHF EC in May 2025.

The WG's governance is composed of representatives from NMHSs across South Asia, with support from RIMES and the UK Met Office. Dr. OP Sreejith, Scientist F from India Meteorological Department (IMD), and Dr. Quamrul Hassan, Deputy Director for the Bangladesh Meteorological Department (BMD), were appointed as co-chairs for the Climate Services Working Group. Its members are:

Country	Name	Designation	Organization
Afghanistan	**Mr. Fawad Auobi**	Head of the Forecast Department	AMD
Bhutan	**Mr. Ugyen Chophel**	Dy. Chief Statistical Officer	NCHM
India	**Dr. AD Tathe**	Scientist F	IMD
India	**Dr. Satyaban B. Ratna**	Scientist E	IMD
Maldives	**Mr. Ahmed Shabin**	Senior Climatologist, Climate Division	MMS
Pakistan	**Dr. Faisal Saeed Syed**	Director, R&D Division	PMD
Sri Lanka	**G.K. Hendawithrana**	Deputy Director (Climate Studies & Training)	DoM

Official nomination from Myanmar and Nepal are still pending.

2.2 Summary of Country Presentations

NMHS participants from Afghanistan, Bangladesh, Bhutan, India, Myanmar, Maldives, and Sri Lanka presented an overview of Climate Services in their respective countries. The session provided an opportunity to share their experience in their ongoing activities and priorities on Climate Services, and identify gaps and capacity needs to inform the working group's work plan. Insights gathered were particularly on the: a) status of climate services, b) forecast products and delivery, c) sectoral advisories and applications, d) tools, platforms, and data use, e) capacity gaps, and f) expectations from the SAHF CS WG.

Afghanistan's Meteorological Department (AMD) provides climate services primarily by leveraging external models and products from sources like NASA, CPT, and RIMES for seasonal forecasts of precipitation and temperature, available on their website in multiple languages. They observe and warn about extreme weather events like monsoon rains, flash floods, and heatwaves. AMD uses regional data sources but lacks its own climate models and faces significant data gaps from 1977-2005 across its approximately 56 stations. They identified a strong need for regional cooperation and training in data management, seasonal forecast modeling, and developing in-house climate production tools to improve accuracy and self-sufficiency.

The **Bangladesh Meteorological Department (BMD)** offers climate services including historical data and monthly/seasonal Outlook forecasts, with experimental co-production efforts with RIMES for agriculture, health, water, and livestock. BMD hosts regular Climate Outlook Forums, and is developing various forecasts (monthly, seasonal, sub-seasonal) including weekly forecasts. BMD utilizes tools like CPT, Py-CPT, and XCAST, relying on global climate products and collaborating with organizations like the Norwegian Meteorological Institute for climate projections. Key challenges include data availability issues with existing tools, the absence of a common data format for different model outputs, a need for internal capacity building, and improving user engagement and communication.

Bhutan's **National Centre for Hydrology and Meteorology (NCHM)** operates under the "gross national happiness" philosophy guiding its climate services. NCHM provides information to sectoral ministries and uniquely integrates indigenous astrological outlooks into its annual National Climate Outlook Forums (NCOFs) to build user trust, viewing this as more effective than purely scientific tools in maintaining public faith. While they provide general climate reports and attend regional forums for seasonal outlooks, NCHM currently does not offer sub-seasonal or monthly forecasts and faces significant capacity gaps in observation, modeling, tailored services, and data management, hindering its ability to operationalize S2S forecasting due to limited access to global centers.

The **India Meteorological Department (IMD)** is a leading regional climate center, offering extensive sectoral climate services for disaster management, agriculture, water, and health, and expanding into finance. They issue long-range, monthly, and weekly forecasts for various phenomena (monsoon, heatwaves, cold waves) using multimodal ensemble techniques, and contribute to WMO reports. IMD employs a seamless forecasting system and develops operational products like drought monitoring, sub-basin rainfall forecasts, and health bulletins for vector-borne diseases, all freely available online. While highly advanced, IMD is implementing a National Framework for Climate Services (NFCS) through multi-institutional collaboration to identify and address remaining gaps and promote co-development of services.

Climate services are a recent development at the **Maldives Meteorological Service (MMS)**, with a single staff member in their climate section, leading to continuity challenges. MMS conducts Monsoon Forums, often dependent on funding, and issues Rainfall and Temperature Outlooks, though timing issues arise with their peak rainy season. Monthly forecasts are

uploaded to their website using CPT and global outputs, but user engagement remains low. MMS lacks dedicated climate service tools but is developing DSS platforms with RIMES and has long-term observation stations for data validation. Major gaps include a lack of local modeling and research expertise, funding for contextualization and user engagement, and a language barrier between scientific forecasts and user sectors like tourism and agriculture.

Myanmar's **Department of Meteorology and Hydrology (DMH)** issues general weather outlooks and seasonal forecasts twice a year through its National Monsoon Forum, also providing climate projections up to 2100 to various sectors. DMH utilizes regional and S2S forecast outputs with CPT tools, incorporating historical data. They experienced record high temperatures in 2023-2024 and issue drought information. DMH provides specific advisories for agriculture (decade-long forecasts), water (flood bulletins, dam management), health (heat stroke warnings), and disaster management, disseminating information widely through various media. Significant capacity gaps exist in technical and institutional areas, including updating climate scenarios, pilot projects, staff training, and real-time data sharing.

Sri Lanka's **Department of Meteorology (DoM)** provides a comprehensive range of forecasts (3-day, weekly, monthly, seasonal) and climate projections, offering sector-specific advisories in collaboration with agriculture, disaster management, and water resources agencies. They host two annual National Monsoon Forums, engaging sectoral users and integrating feedback. DoM forecasts rainfall and temperature, monitors drought, and uses diverse delivery channels including web dashboards, a mobile app, and social media. Tailored advisories inform decision-making in agriculture (crop calendars), water resources (reservoir management), disaster management (relief pre-positioning), health (dengue forecasts, heat action plans), and energy (hydropower outlooks). DoM uses a Climate Portal, various in-house tools, and integrates global products with local observations and indigenous knowledge. While possessing skilled staff and good coordination, technical gaps include limited local downscaling, inadequate high-resolution datasets, and insufficient climate data infrastructure. Challenges in user engagement, funding, and sustainability due to short-term, donor-driven projects and recruitment halts also persist.

1.2.1 Common Themes

Commonalities among the countries include, to a varying degree, reliance on global producing centers and regional data sources for seasonal and sub-seasonal forecasts. Production of these forecasts, primarily on precipitation and temperature, is tailored for critical sectors such as agriculture, water resources, disaster management, and health – with whom many countries actively collaborate through regular meetings, forums, and the co-production of advisories. Participation in Regional Climate Outlook Forums, such as the South Asia Climate Outlook Forum (SASCOF), and National Monsoon Forums were highlighted as a crucial mechanism for disseminating forecasts, gathering feedback from sectoral users, fostering inter-agency collaboration, and sharing regional information.

On the other hand, specific challenges cited were data gap, lack of high-resolution downscaling, and inadequate funding for operational services and training. Capacity gaps identified were on technical expertise, data access, management, and infrastructure, tool development and application, institutional coordination and user engagement, and sustainability.

1.2.2 Expectations from SAHF CS WG:

The country presentations' expectations from the SAHF Climate Services Working Group primarily centered around enhancing technical capabilities, improving data infrastructure, fostering collaboration, and securing sustainable funding, particularly:

- **Capacity Building and Training**: There is a strong need for technical training in diverse areas such as meteorological instruments, data quality control, GIS, aviation and satellite meteorology, and IT. There is also demand for skill development in climate research, modeling, seasonal forecasting, and newer technologies like AI for bias correction and big data management. Training in statistical and dynamic downscaling, impact modeling, and forecast interpretation is also sought after.

Beyond technical workshops, peer-to-peer exchanges and joint training programs are recommended for promoting cross-country learning and broader perspectives.

- **Data Access, Management, and Platforms**: Countries highlighted the urgent need to improve data infrastructure, including better access to observational equipment, filling historical data gaps, and upgrading data management systems. High-resolution observed grid data for rainfall and temperature are in demand to validate model outputs and support analysis.

There is also a strong push for a unified regional data platform with standardized APIs and metadata to enable real-time data sharing, especially for sub-seasonal to seasonal forecasts and bias-corrected products. Open-source climate data systems are favored for ensuring accessibility and interoperability across countries.

- **Tool Development and Application**: Members are looking for assistance in developing and implementing advanced tools. This includes the creation of a South Asia-specific tool usable by all countries, as well as the development of sectoral decision support systems (DSS). There's a particular interest in tools for climate risk mapping, user-tailored product design, and supporting the development of impact-based forecast chains (e.g., for crop yields or reservoir inflows).

- **Collaboration and Regional Frameworks**: A regional approach is highly emphasized, with expectations for fostering stronger partnerships among government bodies, academic institutions, stakeholders, and the private sector. This involves creating collaborative plans for sharing data, research findings, and best practices. The establishment of a regional framework for climate services in South Asia is a key aspiration, along with prioritizing the implementation of NFCS in each country. Members also seek to co-develop region-wide multi-modal outlooks and impact maps for various sectors, and to standardize forecast verification methods across the region.

- **Funding and Sustainability**: Sustained investment is seen as essential, especially for acquiring and maintaining critical meteorological infrastructure and spare parts. Access to global climate funds is crucial to scale up services and demonstrate their value to governments.

2.3 Reflection from the user sectors:

Representatives from the user sector provided further insights and reflections on how their respective sector uses forecast products. Dr. Mirza Waseem Abbas, Deputy Director for Crop Rotation Service from the Punjab Agriculture Department, shared the Department's efforts in Pakistan like the piloting of the Agro-meteorological Advisory System (ADVISE) DSS developed with RIMES, and the crop insurance program to protect farmers from the adverse effects of climate change.

Dr. Sheikh Sayidul Haque, Additional Director General for Planning and Development from the Directorate General of Health Services (DGHS), addressed the health impacts of climate change in Bangladesh, detailing both direct and indirect effects on health services. He stressed the importance of reliable seasonal forecasts for health systems to prepare for emerging challenges and called for a resilient health system that integrates services at various levels. Funding and regular training were identified as essential for sustaining health programs.

The discussions emphasized the need for stakeholder education on the use and application of forecast products onto the respective sectors, and stronger, long-term regional collaboration for research and development and exchange of best practices.

2.4 Regional Insights Insight and Priorities

Following the presentations from NMHSs and insights from the user sectors, an interactive discussion among groups was initiated to examine regional priorities that would become inputs to the CS WG work plan.

- **Barriers to delivering and applying climate services**:
  - For S2S and Seasonal Forecasts, key obstacles include insufficient spatial resolution and scale, challenges with interpreting and accessing data for longer lead times, and concerns regarding forecast accuracy and reliability. Users often lack awareness of forecast uncertainty, which hinders effective decision-making. The non-uniformity of forecast products across different time scales (monthly, seasonal, annual, decadal, climate change) further confuses non-expert users. Human resource limitations and interdepartmental coordination issues also impede application, as does limited end-user engagement.

  - For Historical and Present-Day Climate, barriers include limited access to climate data. The rapid evolution of methodologies raises questions about the predictability of older data for current scenarios, and an over-reliance on satellite data alone complicates future forecasting. Significant data gaps are a major obstacle to understanding climate variability and change in specific regions.

  - For Future Climate, there is insufficient capacity to assess and interpret climate projections, coupled with inadequate infrastructure, tools, and human resource capacity. A particularly significant barrier is the challenge of convincing policymakers to utilize projections for decision-making and securing their political support. Additionally, scientific information in climate change reports and seasonal forecasts is not always easily digestible by users, underscoring the need for effective sector-wise communication. Some regions in South Asia are also not familiar with climate projections for their area.

- **Strongest opportunities for regional collaboration:**
  - Regional Climate Application Forums offer platforms for expert opinion, brainstorming, and knowledge sharing across diverse sectors like agriculture, health, and livestock. Leveraging existing collaborations among NMHSs through SASCOF and sectoral user forums can further advance these efforts.
  - Collaborative efforts on sharing knowledge, products, and resources among regional platforms are crucial. Cross-learning exchange programs, such as staff exchanges, can facilitate knowledge and experience transfer.
  - Establishing a common data platform for access and sharing among NMHSs and other regional entities is vital. Joint efforts in sensitization, outreach, and last-mile connectivity can enhance understanding and use of climate information.
  - Collaboration on research to understand the impact of inter-seasonal oscillations and other climate drivers on the South Asian climate is also a key opportunity.
  - Training and collaboration on using regional reanalysis products can help address data gaps.
  - Implementing effective feedback mechanisms for stakeholder engagement was also identified as a crucial area.
  - Integrating policy advocacy as a key item in regional activities will help secure political support for climate initiatives.

- **Capacity building and technical support requirement:**
  - Understanding and performing skill assessments of models, and providing calibrated, nationally specific, ensemble-based forecasts, which requires robust observations, model understanding, and calibration tools.
  - Facilitating access to and use of high-resolution gridded datasets, including existing reanalysis products, is essential.
  - Preparing for and utilizing newer, higher-resolution global climate simulations is crucial.
  - Knowledge sharing and leveraging innovations in AI and machine learning-based approaches to downscaling are highlighted.
  - Collaboration on developing and sharing decision support tools for various sectors across countries is highly beneficial.
  - Tool and product design, capacity building, and training for impact-based forecasting at the sectoral level is critical.
  - Climate field schools to extend knowledge, data, and forecasting down to end-users.
  - More collaboration and assistance for the development and operationalization of Decision Support Systems at the sub-national level.
  - Developing climate services tools specifically targeting the region or sub-region would enable better public explanation.
  - Improving the accuracy of climate models is a continuous need.
  - Training for user sectors on translating forecasts, explaining case studies, and understanding forecast uncertainty is also vital.
  - Running climate models on national servers, particularly in countries like Afghanistan, would significantly enhance climate services.
  - Specific training in agrometeorology is also requested.
  - Training and support to link policy and decision makers, raising their awareness of climate projections and inherent uncertainties, is crucial.

I.2 Session 2: Technical Brainstorming on the Application of Seasonal and Sub-seasonal Forecast

This session explored the application of multi-timescale forecasts, particularly seasonal and sub-seasonal (S2S), in strengthening decision support tools and climate services. S2S forecasts offer a crucial window for anticipatory planning and early action, yet its uptake remains limited due to challenges in data accessibility, forecast interpretation, and integration into sectoral workflows.

Through expert presentations and interactive discussions, participants examined opportunities to enhance the use of S2S information across sectors. Highlights included the evolution and application of S2S forecasts for user-oriented advisories, strategies for integrating forecasts into climate services to reduce economic risks, development of national and regional outlooks such as the 2025 Monsoon Outlook for Bangladesh, and the introduction of decision support systems like the Climate Services Toolkit (CST) and the National Livestock Advisory System (NLAS).

During the discussions, several areas were identified for further action and consideration. At the policy level, strategic actions remain limited, constraining the scaling and sustainability of successful pilot projects; stronger evidence, including quantified potential impacts under different climate scenarios, is needed to inform high-level decision-making. Integrating S2S forecasts into a broader multi-timescale and multi-hazard framework, supported by user-friendly tools, will be key to ensuring its accessibility and operational use. Equally important is the effective dissemination of national outlooks, such as the 2025 Monsoon Outlook for Bangladesh, down to districts, sub-districts, and local communities, which would benefit from capacity-building of local authorities to empower them in applying the Outlook into planning.

2.1 Context Setting: Seasonal and Sub-Seasonal Forecasts

Dr. Quamrul Hassan, Deputy Director from BMD, provided an overview of S2S forecasts designed for the user sectors. He focused on the evolution and application of S2S, highlighting its potential to significantly improve actionable advisories for various sectors, especially when combined with AI and tailored guidance.

Key Insights:

- The 10-to-30-day forecast window was historically a "prediction desert" due to poor forecast skill. WMO initiated efforts to address this gap, leading to the S2S project in 2013, which concluded its second phase in 2023. The WMO now officially refers to this as the Sub-Seasonal Forecast (SSF). The skill of SSF is continuously improving.
- Distinction Between Forecast Accuracy and Skill: **Accuracy** refers to whether a forecast correctly predicts the general conditions (e.g., dry season forecast being dry), while **skill** refers to the ability to predict specific events or deviations from climatology (e.g., forecasting rainfall during a normally dry period and it occurring). A forecast has no skill if it simply predicts what is climatologically normal.
- Applications of SSF:
    - European Centre for Medium-Range Weather Forecasts (ECMWF) outputs are valuable for identifying the likelihood of cyclone or depression development in specific weeks over regions like the Bay of Bengal and Arabian Sea.

- **Heatwave Prediction:** Weekly SSF provides more precise information for heatwave occurrences than monthly forecasts, as demonstrated by the April 2024 heatwave in Bangladesh.
- **Sectoral Advisories:** SSF can be integrated into a common platform with sectoral data (e.g., crop stages, animal conditions) to generate AI-driven, human-validated advisories for agriculture, livestock, and health.

Recommendations:

- Focus on developing and disseminating forecasts that demonstrate true skill by predicting deviations from climatology, rather than just general accuracy.

- Enhance granularity of forecast information by providing quantitative values (e.g., temperature or rainfall deviations with probabilities) and adopting standardized multi-category systems for nuanced interpretation. Integrate AI to auto-generate sector-specific advisories based on sub-seasonal forecasts and scenario-based guidance, and establish a shared digital platform where NMHSs and sectoral experts can collaborate, validate, and disseminate forecasts and warnings.

- Support the development of sector-specific indices like the Temperature Humidity Index (THI) for livestock, while leveraging regional and global networks to enhance climate services and capacity. Emphasize advanced research to improve 10–30-day sub-seasonal forecast skill through the integration of new data sources and AI/machine learning techniques.

2.2 Integrating S2S Forecasts for Climate Services

Mr. Raihanul Haque Khan, RIMES Country Program Lead for Bangladesh, highlighted the critical need to proactively integrate S2S forecasts into climate services to minimize economic losses and enhance resilience across various sectors. While short-term early warnings excel at humanitarian evacuation, there's a significant gap in using longer-term forecasts for strategic, pre-emptive actions that mitigate broader economic impacts.

Key Insights:

- There's a strong drive to move beyond just immediate humanitarian response (evacuation based on short-term warnings) towards proactive disaster risk management, which includes minimizing loss and damage in key economic sectors using S2S forecasts. However, challenges remain in using S2S forecasts for strategic decisions in sectors that require more lead time than immediate hazard warning provision (e.g. agriculture, transport, health).
- The economic cost of disasters continues to rise significantly, underscoring the urgency for more comprehensive and proactive risk reduction strategies.
- While human health impacts of events like heatwaves are widely recognized, their severe effects on sectors like agriculture, livestock (e.g., poultry deaths), and infrastructure (e.g., buckling roads, railway tracks) are often underestimated or not adequately prepared for.
- Climate events have far-reaching and cascading economic consequences, extending beyond immediate localized damage to affect national GDP, energy demand, fuel imports, and even inflation. Transboundary impacts are also significant.
- Even without precise quantification, qualitatively identifying potential impacts from extreme seasonal forecasts (e.g., "wetter monsoon" leading to "higher chances of extreme rainfall" in certain basins) can enable strategic pre-positioning and action planning.

- S2S forecasts should not be standalone solutions but integrated into a broader multi-time scale (short-term to long-term projections) and multi-hazard approach, considering cascading effects (e.g., a cyclone leading to flash floods inland).
- Proven Benefits of S2S in Practice:
    - Sri Lanka (2015-16): Strategic decisions based on above-normal rainfall seasonal forecasts for reservoir water release avoided approximately $41 million USD in damages.
    - Bangladesh (Flood Outlook): Sub-seasonal flood outlooks informing farmers about *low probability* of flooding enabled them to harvest paddy, which hadn't been possible in previous years.
    - Philippines (Climate Field Schools): Long-term engagement (12 years) through climate field schools, supported by local government ordinances, has sensitized farmers to S2S forecasts, leading to 10-15% increased production and sustained operations.
    - India (Agri-Met Services): Structured agri-meteorological units and KVKs have led to over 98% farmer adoption of forecast-based advisories, resulting in an estimated annual income gain of $1.6 billion USD in rain-fed districts.
- Despite the proven value and available information, strategic actions at the policy level are often limited or lacking, hindering the scaling and sustainment of successful pilot projects.
    - Systems alone don't make decisions; institutional capacity and arrangements are needed to ensure forecasts are fully utilized.
    - S2S products are often national-level, while sectoral actions are typically local, requiring co-production and interpretation.
    - S2S forecasts are not always straightforward to interpret and often require forecaster judgment and tweaking.
    - Projects often focus on single timescales or hazards, impeding a comprehensive programmatic approach.
    - Challenges remain in effectively communicating the inherent uncertainties in S2S forecasts to end-users and policymakers.

Recommendations:

- Promote the systematic use of sub-seasonal to seasonal (S2S) forecasts in operational planning across sectors such as agriculture, health, energy, and transport.
- Collaborate with sectoral experts to co-produce tailored bulletins and advisories that translate S2S information into locally relevant, actionable guidance. Expand focus beyond human health to address climate impacts on agriculture, livestock, infrastructure, and supply chains, enhancing preparedness and response strategies.
- Advance policy frameworks and financial mechanisms that institutionalize the use of S2S forecasts, taking inspiration from national protocols and local ordinances.
- Make S2S forecasts accessible through user-friendly tools, plain language summaries, and visual aids that support decision-making by non-specialists. Clearly convey forecast uncertainties and their implications to enable risk-informed actions based on probabilistic information.
- Replicate proven models such as Climate Field Schools and Agri-Met services by embedding them in long-term, context-sensitive partnerships with local governments and communities.

2.3 Overview of the Monsoon Outlook Forum for 2025 in Bangladesh

Mr. Asif Bin Noor, RIMES Climate Services Expert, detailed the collaborative process and contents of the 2025 Monsoon Outlook for Bangladesh, highlighting its aim to provide decision-makers with crucial information on rainfall and temperature patterns, along with sectoral advisories. A significant challenge remains in effectively disseminating this national-level outlook to local communities.

Key Insights:

- The Monsoon Outlook for Bangladesh is a collaborative effort involving RIMES, the Bangladesh Meteorological Department (BMD), and relevant sectoral agencies. This process has been refined since 2021 and includes: global products and using customization tools (CPT, Xcast), consensus forecasting by BMD, advisory generation from sectoral focal points (agriculture, livestock, health, flood forecasting, fisheries), conduct of Climate Application Forum workshop to showcase, fine-tune, and validate forecasts and advisories with participants' remarks, and final outlook production for both monsoon and winter monsoon seasons.
- Efforts are made to make the outlook visually appealing and simple for a wide range of stakeholders, including community members, to understand.
- The outlook provides:
    - Rainfall Forecasts: Monthly (e.g., June) and seasonal (June-September) outlooks indicating above normal, near normal, or below normal rainfall for different parts of the country (e.g., above normal in northeastern/northern parts for June).
    - Temperature Forecasts: Average, minimum, and maximum temperatures for June, and the full JJAS monsoon season, often showing above normal temperatures, particularly in the northeast and coastal/southeast areas, with probabilities (e.g., 40-50% probability of above normal).
- Based on the forecasts, detailed advisories are generated for:
    - Agriculture: Recommendations for optimized irrigation (e.g., alternative wetting and drying for below normal rainfall), delayed transplantation, and other specific advisories for various rainfall scenarios (above, near, below normal), primarily focusing on rice.
    - Livestock: Guidance on coping with higher temperatures throughout the monsoon.
    - Fisheries: Specific advisories for potential flooding in northern Bangladesh and strategies for high-temperature conditions.
    - Flood and Water Management: Encouragement to follow BMD's website and regular bulletins (5-day, 10-day, 15-day, 1-month outlooks) for real-time flood monitoring and action.
    - Health: Advisories (developed by IEDCR) related to vector-borne diseases (dengue, chikungunya, malaria) due to high temperature and humidity, as well as water and foodborne diseases, and general recommendations.
- Despite the refined process and comprehensive content, a major ongoing challenge is the effective communication of this national-level document to the district and sub-district levels, and ultimately to local communities. This also hinders feedback collection on forecast performance and good practices.

Recommendations:

- To strengthen local-level dissemination and action, it's crucial to empower local authorities to utilize national Monsoon Outlooks. This means localizing information into actionable

advisories, establishing feedback mechanisms for continuous refinement, and leveraging existing local networks to ensure advisories reach the "last mile."

- Continue to refine the visual appeal and simplicity of the outlook to ensure it is easily understandable by diverse stakeholders, including those with limited technical backgrounds.
- Maintain the existing collaborative framework with BMD and sectoral agencies, ensuring regular forums and workshops for co-production and fine-tuning of advisories.
- While the report mentions ongoing efforts, further work could be done to quantify the potential impacts of various climate scenarios (e.g., specific yield reductions in agriculture due to extended heatwaves) to better inform decision-making.
- Reinforce the recommendation for users, especially in flood-prone areas, to regularly check BMD's shorter-term bulletins (5-day, 10-day, etc.) in conjunction with the seasonal outlook for dynamic decision-making.

2.4 RIMES DSS: Climate Services Toolkit

Mr. Jie Qiu, RIMES Team Leader for Server and Data Management, introduced the Climate Services Toolkit (CST), a web-based system designed to provide climate data analysis and predictions for both country-wise and regional use. Developed through the WMO initiative, CLIMSA project, CST supports 20 countries across eight different Regional Climate Centers (RCCs). The system is designed with different user permissions, allowing normal users to access country-specific data and expert users to view regional data.

This presentation introduced the Climate Services Toolkit (CST), a web-based system designed to provide climate data analysis and predictions for both country-wise and regional use. Developed under the CLIMSA project (a WMO initiative), the CST aims to support 20 countries across eight different Regional Climate Centers (RCCs), initially focusing on African regions. The system is designed with different user permissions, allowing normal users to access country-specific data and expert users to view regional data.

Key Features:

- Climate Data Analysis:
  - Allows users to visualize monthly or seasonal climatology using historical data, currently integrating ERA5 data from 1940 to 2024. Future plans include upgrading to ERA6 and combining with CMIP7 for climate change analysis.
  - Enables the calculation of SPI for user-defined periods. A future enhancement will include the Temperature Humidity Index (THI) for applications like animal health and national tourism.
  - Integrates ECMWF IFS 15-day forecasts, updating daily, to provide indices such as wet days, summer days, dry days, and tropical nights. Historical indices (1980-2022) are also available for comparison

- Climate Predictions:
  - Offers tools to evaluate the performance of various climate models (currently 8 models, with plans to add more) against observation datasets like ERA5, CHIRPS v2, and CRU (ERA5 is fully tested). Users can analyze metrics such as anomalies, correlation variance, root mean square error, and anomaly coefficient to identify optimal models for specific regions. The current hindcast year limit is 2016 due to data gaps in some models, but an AI model to generate missing data is under development.
  - Generates seasonal forecasts, providing probabilities for below normal, near normal, and above normal conditions based on selected models.

- Allows users to upload their own observation data for specific stations using a provided template. Future plans include integrating AI to convert station data into gridded data, enabling users to incorporate their observations into weather forecasts.

The Q&A session highlighted several technical clarifications and future directions for the CST. It was clarified that while CST provides monthly and seasonal forecasts, it does not directly offer flood prediction services due to the computational demands of hydrological modeling across multiple countries. Instead, users can download forecast data for integration into their national models. Plans are underway to incorporate S2S data, particularly from African RCCs, and users expressed interest in additional functions, such as comparing station data with reanalysis datasets like ERA5—an enhancement the developers consider feasible for country-level use.

Other topics included forecast validation, where it was noted that models undergo ROC-based testing prior to integration, with CST serving mainly as a data access and comparison tool. Users can upload station data for point-based comparisons, though generating gridded outputs requires dense data and careful interpolation. The system supports flexible data-sharing policies, with tiered access for countries and RCCs. Long-term projections remain outside CST's scope, instead available through other platforms. The session closed on a collaborative note, confirming CST's development under the WMO's CLIMSA program, with strong interest in deepening ties to WMO datasets and expert networks.

2.5 RIMES DSS: National Livestock Advisory System (NLAS)

Mr. Asif Udin Bin Noor, RIMES Climate Services Expert, introduced the National Livestock Advisory System (NLAS) developed under the World-Bank funded CARE Project. NLAS is designed to support decision-making in Bangladesh's livestock sector by providing multi-time scale forecasts and alerts for weather conditions affecting livestock health. It addresses the critical impact of climate extremes, such as high temperatures, flooding, and heat stress, on livestock health, disease prevalence, milk production, and poultry mortality.

Key Features:

- An alert system that provides real-time, district-level alerts for rainfall, wind, heat, cold waves, and Temperature Humidity Index (THI) for poultry and cattle, enhanced by a temperature bias correction tool for improved accuracy.

- Users can explore interactive maps, five-day forecasts, and THI-specific warnings crucial for livestock management. The platform also visualizes BMD's observation network, historical climatology, climate outlooks, and future projections based on user-defined parameters (e.g., SSP scenarios, seasons, temperature thresholds), aiding in climate-informed decision-making.

- Specialized tools include disease analytics for Foot-and-Mouth Disease (FMD), offering clustering and predictive risk maps.

- Monthly livestock advisories tailored to seven climate-livestock zones can be customized and disseminated via email. The adaptation module allows users to generate district-specific plans that consider hazards, vulnerabilities, and livestock characteristics, downloadable as PDFs. Additional features include heatwave/cold wave bulletins, flood monitoring, and a robust admin panel for communication and data management.

The discussion addressed the use of THI thresholds, with the presenter noting that current values are based on Australian standards due to the lack of localized research. It was agreed that developing breed-specific thresholds for Bangladesh would enhance the system's relevance. A key feature—the chatbot—was also discussed; it is trained on over 60,000 SMS records and can interpret phonetic Bangla, making it a valuable, accessible tool for community engagement and responsive information delivery.

2.6 Regional Climate Modeling and Data Systems

2.6.1 RIMES DSS: Regional Data Analytics System (RDAS)

Ms. J Elaine Layug, M&E Specialist for RIMES, provided an overview of the Regional Resilience Data Analytic Services (RDAS) tool, developed by RIMES under the Climate Adaptation and Resilience (CARE) Project. RDAS is designed to integrate climate and sectoral data, providing actionable information to support decision-making across various sectors like agriculture, livestock, transport, water, and disaster management. It serves as a central hub for diverse datasets and analytical tools, aiming to enhance climate resilience in pilot countries such as Bangladesh, Nepal, and Pakistan.

Key Features:

RDAS is built upon three key pillars: data, analytics, and predictive tools. For data, ARDAS currently houses approximately 358 climate and sectoral datasets, including reanalysis data like ERA-5 and climate projections from CMIP6. It also allows users to upload their own data. The analytics pillar comprises six operational tools that analyze trends and patterns between climate drivers and climate parameters, as well as their impact on sectoral information (e.g., crop yield). These tools include assessments of El Niño/La Niña impacts, cropping calendar suitability, rainfall anomaly detection, and land use/land cover change monitoring. The predictive tools pillar features four operational tools that forecast potential impacts of weather and climate phenomena, such as the El Niño/La Niña local climate prediction, a temperature sensitivity alerting system for livestock, and growing degree days.

Future plans for RDAS are incorporated in the three to five-year roadmap developed through series of consultation with the World Bank and stakeholders, incorporating their demands, priorities, and recommendations. Further developments may include refinements of existing systems, integration of additional climate drivers, and broadening the scope or functionality of current tools, such as expanding the livestock-focused temperature sensitivity alerting system to human applications.

2.6.2 IITM: Coordinated Regional Downscaling Experiment (CORDEX)

Dr. TP Sabin, Senior Scientist from the Center of Climate Change Research at the Indian Institute of Tropical Meteorology (IITM), discussed the CORDEX initiative for generation and availability of climate data. CORDEX aims to provide high-resolution climate projections for impact and adaptation studies in the South Asian region, which is characterized by complex terrain and a monsoon-dominated climate.

Key Features:

IITM plays a leading role in CORDEX South Asia (Region 6), generating downscaled climate simulations from global climate models (CMIP). Currently, they offer 50 km and 22 km resolution simulations based on CMIP RCP scenarios, and new 27 km and 15 km simulations

from CMIP6 downscaling. These simulations cover historical periods and future projections using Shared Socioeconomic Pathways (SSPs), specifically SSP245 (moderate emission) and SSP585 (high emission). The presentation highlights the use of climate drivers like greenhouse gas concentrations and aerosols as inputs to their models. A significant advancement is the use of an atmospheric version of their Earth System Model, which demonstrably improves the simulation of complex regional features like narrow orographic precipitation, monsoon annual cycle, and crucially, North Indian Ocean cyclones.

A new version of the CORDEX South Asia datasets will be released soon. Development of a uniform analysis protocols across member states in the South Asian region, similar to what is followed by initiatives like SASCOF, would foster consensus-based climate pattern recreation for the entire region, ultimately providing more solid contributions to climate adaptation efforts.

2.6.3 Open Discussions on Regional Climate Modeling and Data Systems (RDAS & CORDEX)

Discussions revolved on efforts to make climate data more accessible and useful. A key query for RDAS concerned its data sources, with clarification that it aggregates products from existing regional and global platforms, rather than generating its own raw climate data. Specifically, RDAS uses an ensemble mean from 26-28 CMIP6 models selected for their suitability in the monsoon season, rather than offering users the option to choose individual models. This design decision prioritizes the platform's goal of building applications for country-level sectoral impact assessments, with model selection handled at the backend. RDAS currently focuses solely on South Asian regional data.

On CORDEX South Asia, concerns were raised about the limited number of available CMIP6 models (only three initially) and delays in data release compared to other sources like Next NASA. The explanation provided was that many modeling centers are now focused on CMIP7, leading to less computational dedication to CORDEX South Asia for CMIP6 downscaling. However, efforts are underway to include more ensembles from other groups. A significant development highlighted was the CORDEX South Asia's new 27km resolution simulations, which show improved representation of complex regional features and crucially, North Indian Ocean cyclones. There was also a recommendation to include Arctic and Antarctic ice changes in the new CORDEX simulations. A request was made for CORDEX data to be integrated into RDAS, which is planned, though it will require development work to handle data formatting differences.

Sustainability and user engagement were also prominent themes. A participant from Pakistan emphasized the importance of institutionalization and ownership of platforms like RDAS beyond project lifecycles, suggesting continuous feedback mechanisms and system-to-system integration for data sharing with provincial agriculture departments, as agriculture is now a provincial subject. There was also a call for standardizing optimal resolution guidelines for sectoral planning across countries and encouraging the publication of local context-based literature using RDAS data to foster greater ownership and academic engagement.

RIMES affirmed its commitment to sustainability through integrating systems into country-level institutions and seeking further funding for enhancements. IITM, through Dr. Sabin, expressed willingness to share analysis codes for regional assessments and to collaborate on model performance reviews for the South Asian region.

I.3 Session 3: Operationalising the SAHF CS WG

2.1 Overview of the Regional Framework for Climate Services

Joseph Daron, Climate Services Specialist from the UK Met Office, provided an overview of the Regional Framework for Climate Services (RFCS) to jumpstart the ideation and discussion on the CS WG work plan. He explained that RFCS acts as a coordinating mechanism aimed to enhance the co-production, tailoring, delivery, and use of science-based climate predictions and services for decision-making in climate-sensitive sectors at a regional scale.

Key components of an RFCS include defining regional-to-national linkages, establishing clear governance with roles and responsibilities, identifying priority sectors, and developing a comprehensive, actionable, and costed action plan with robust monitoring, evaluation, and learning mechanisms.

2.2 Presentation of Draft Work Plan

The CS WG work plan aims to strengthen climate services across the South Asian region. The plan, still in draft form and open for refinement, covers several key themes:

1) **Regional Framework for Climate Services** - acts as an enabler for coordination, collaboration, and enhancement of science-based climate predictions. This involves reviewing WMO guidance, learning from other regions, and supporting national frameworks.
2) **Data Access, Use, and Sharing** - activities are centered on data rescue, filling gaps, enhancing access to regional and national climate datasets (including IMD reanalysis and CORDEX simulations), and promoting data quality and sharing protocols.
3) **Capacity Building** - addresses training needs for producers and users of climate information at regional and national levels. This includes conducting needs assessments, developing training materials, and delivering capacity building initiatives.
4) **Tools and Decision Support System Development** – activities ensuring awareness, access, and proper utilization of tools and DSSs
5) **User Engagement** – the “backbone” of climate services; activities emphasizes strengthening user forums, promoting impact-based information, and establishing regular dialogues with diverse stakeholders, while also considering vulnerable communities and gender equality.
6) **Enabling Policy and Institutionalisation** – activities that will ensure sustainability and support wider investment in climate services.

A succeeding interactive discussion delved deeper on each of the themes, gathering insights and recommendations from representatives from the NMHSs, user sectors, and development partners.

- **RFCS and User Engagement**

The discussions underscored the potential for the SAHF CS WG to act as the implementing body for the RFCS in South Asia. The concept of a regional framework aligns closely with the working group's objectives to coordinate, facilitate, and strengthen collaboration among regional and national institutions to enhance the co-production, tailoring, delivery, and use of science-based climate predictions and services for decision-making in climate-sensitive socioeconomic sectors. Benefits of such a framework include improved stakeholder interaction, clearer responsibilities and mandates among institutions, and ultimately better development and use of climate information for socioeconomic benefits and adaptation planning.

The discussion also noted that RCOFs are crucial enablers for these discussions, potentially extending its scope to include sub-seasonal to decadal predictions and climate change projections. Specific activities suggested included demonstrating climate services in sectors like energy in Bhutan, integrating extreme weather prediction into decision support systems, and linking with ongoing projects in countries like Sri Lanka that aim to develop decision support systems. The replication of successful training programs from other regions in South Asia and synergy with initiatives in Pakistan supported by the International Climate Initiative and GIZ were also proposed. The long-term vision includes the potential release of high-resolution climate projection datasets for South Asia, similar to the V3 8km dataset in the ASEAN region. The need to incorporate regional users, particularly those with transboundary interests, into climate services platforms was also emphasized.

- **Data and Decision Support Systems**

The discussions highlighted the strong need for model verification at different scales, especially for impact-based forecasting, to assess forecast accuracy and impact, which is currently challenging due to limited user sector data. The development of specific guidelines for each component of the work plan was seen as essential to facilitate progress for both user sectors and NMHS. Monsoon forums were recognized as valuable platforms for stakeholder interaction, with a suggestion to emphasize the importance of climate services to encourage greater participation.

Initiating work on future climate scenarios and risk assessment in countries where this is not yet underway was identified as a priority. Short-term priorities include addressing data gaps through satellite or reanalysis data (like IMDA) and conducting country or region-specific forecast verification at various timescales (sub-seasonal to seasonal). Crucially, there is a call to initiate efforts for collecting loss and damage data in collaboration with stakeholders.

Long-term goals encompass the continuous improvement of forecast accuracy, reduction of false alarms, initiation of climate change projections, and fostering collaboration to establish NFCS in each country. The group also emphasized the need for clear technical guidance from SAHF, the working group, or RIMES to assist NMHS in coordinating with higher authorities and stakeholders, particularly for developing NWP-based or impact-based forecasts. There was also a point about making use of existing decadal prediction products from agencies like the UK Met Office and integrating climate change projections from sources like CORDEX and NASA's statistically downscaled products. Data quality control, adherence to WMO and WCRP guidelines, and leveraging existing data exchange protocols among NMHS were also stressed.

- **Capacity Building, Policy Implications, and Sustainability**

Capacity Building was identified as a critical area requiring attention at three distinct levels: community, sectoral, and hydromet agency/producer. The existing Knowledge Hub was acknowledged as a valuable resource, with suggestions to make it more interactive, add new materials, and implement prerequisites for training courses to ensure participants have a foundational understanding. While online mechanisms can address some barriers to training, the importance of both online and in-person training was highlighted. The need for more sector-specific training was emphasized, along with exploring examples of training prerequisites from organizations like the International Federation of Red Cross. The concept of "collective knowledge informing action" was brought up, citing an example from Punjab where farmers' collective understanding influenced agricultural practices.

Other considerations for capacity building included training stakeholders in financial mechanisms, influencing school curricula, and ensuring clarity on various climate-related

terminologies (e.g., climate services, anticipatory action, early warning for all). For producers and Met Services, numerous existing training mechanisms were noted, including SAHF activities, the SAHF Knowledge Hub, the ESCAP portal, WMO Regional Training Centres, WMO Global Campus, and SASCOF pre-training. An immediate action identified was to link and cross-reference these portals and training materials to optimize resource utilization. However, there was a recognized need for greater focus on capacity building for sector and community engagement.

"Train the trainers" approaches were advocated, with suggestions for incentives or mandates to encourage trained individuals to further disseminate knowledge within their organizations. The ability of SAHF to influence national development plans and budgets to include capacity building and training, and to assist countries in writing project proposals, was also discussed. Collaboration with CORDEX and ESCAP for developing and delivering training on climate projections was identified as an immediate action. Regarding policy implications and sustainability, the importance of developing "stories of change" and evidence, particularly cost-benefit analyses and socioeconomic benefits, was stressed to secure ministerial-level buy-in, citing Indonesia's successful climate schools as an example. A survey to assess training needs and available materials was proposed to effectively stock resources, identify needs, and fill gaps.

II. NEXT STEPS

- Incorporate detailed feedback from all participants and development partners into the draft work plan while ensuring alignment with ongoing national initiatives and global/regional frameworks.

- Present the finalised work plan to the SAHF Executive Council for endorsement by September 2025.

- Prioritise activities within the work plan, considering realistic resourcing and leveraging existing and emerging funding opportunities from partners like WISER Asia-Pacific, World Bank (CREWS South Asia), and others.

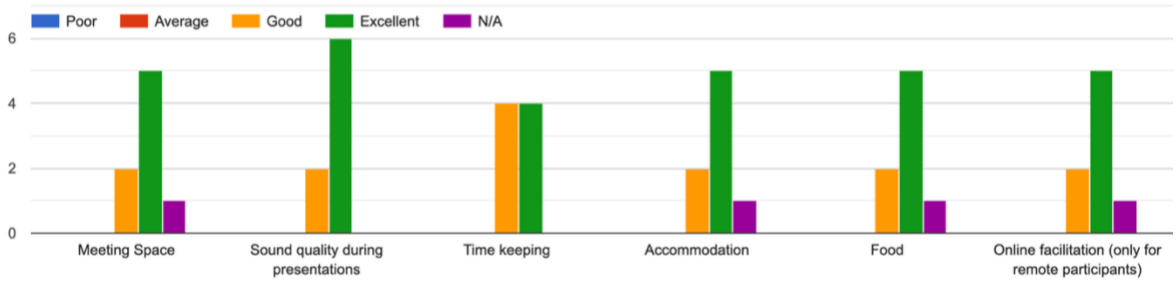
- Maintain active dialogue and regular update mechanisms with regional organizations and development partners to ensure continued alignment and leveraging of resources.

- Consider piloting specific activities at the national level to share learning across the region, potentially linking with the SAHF Impact-Based Forecasting Working Group's temperature-focused pilots.

III. FEEDBACK SUMMARY

The workshop concluded with 19 participants, 12 representatives from the NMHSs and user sectors, and 7 from the development partners. A 42% response rate was achieved for the feedback survey, with the majority of responses (87.5%) coming from NMHSs and user sectors in South Asian countries, and the remainder from a development partner.

In terms of the workshop logistics, all of the respondents expressed satisfaction with the meeting space, sound quality during presentations, time keeping, accommodation, food, online facilitation, and length of the workshop days.



The workshop was highly successful in achieving its objectives, with respondents giving an average rating of 4.78 out of 5.00 (where 5.00 signifies "highly successful"). Overall, participants found the workshop enjoyable (4.88), that it met their expectations (4.88), and that it will be useful in advancing SAHF priorities.

Key aspects that the respondents will share and discuss with their colleagues include: the use of S2S forecasting and its applications, opportunities for regional collaboration, tools and DSSs such as RDAS, and the importance of climate services for sectoral applications and in informing decision-making.

The feedback also highlighted several important questions for consideration in future WG activities, suggesting areas for deeper exploration:

- What institutional frameworks are required for sustained adoption of climate-informed policies?
- How do we ensure data interoperability and long-term maintenance of platforms like RDAS?
- What role can public-private partnerships play in scaling access to climate services for smallholders?
- How can we embed gender and equity considerations more meaningfully into climate service design and delivery?

A key recommendation from the workshop is to continue engaging with stakeholders to further reinforce learning outcomes and maintain the momentum of the Working Group.

ANNEX 1: AGENDA

DAY 1 – Establishing the SAHF CS WG

Time	Session	Details	Lead
08:30–09:00	**Registration**		
09:00–09:15	**Opening Session**	Welcome remarks and overview of workshop objectives and agenda	Dr. K. J. Ramesh, Advisor (Weather and Climate Services), RIMES Mr. David Corbelli, Senior International Development Manager, UKMO
09:15–09:30	**Participants Introduction**	Brief introduction of participants	RIMES
09:30–10:15	**WG Governance**	Appointment of Co-chairs, review and endorsement of Terms of Reference (ToR)	CS WG Members/ RIMES
10:15–10:45	**Group Photo & Coffee Break**		
10:45–12:30	**Country Presentations:** Overview of Climate Services in South Asia	Presentations from countries on the insights of their current status of climate service and application of S2S, seasonal and climate projections ● Afghanistan ● Bangladesh ● Bhutan ● India ● Maldives ● Myanmar ● Nepal ● Pakistan ● Sri Lanka	CS WG Members/Country Representatives
12:30–13:00	**Open Discussion**	Participants reflection on country presentations, highlighting common challenges, opportunities and priorities for regional collaboration	WG Members/Country Representatives/ User Sector Representatives

13:00–14:00	**Lunch Break**		
14:00–15:30	**Interactive Session:** Building on National/Regional Platforms	Lessons and linkages from GFCS, SASCOF, CSUF, and National Outlook Forums	Facilitated by RIMES/UKMO
15:30–16:15	**Plenary Discussion:** Aligning National Insights for the Climate Services Work plan	Synthesizing inputs to inform CS WG workplan and align with ongoing and planned national initiatives	Facilitated by WG Co-Chairs
16:15-16:30	**Coffee Break**		
16:30-17:30	**Preparing draft workplan for the SAHF CS WG**	Workplan prepared based on discussions in above sessions and SAHF EC priority themes: • Enhancing regional coordination • Climate data access and standardization • Stakeholder engagement and capacity development • Resource mobilization and sustainability • Monitoring, evaluation, and workplan implementation	CS WG Members/User Sector Representatives

DAY 2 – Technical Brainstorming on the Application of Seasonal and Sub-seasonal Forecast

Time	Session	Details	Lead
09:00–09:15	**Session Overview**	Recap of Day 1, outline of session objectives and structure	RIMES
09:15–10:30	**Session 1:** Context Setting	Application of S2S for Climate Services: points to ponder and practical examples	RIMES
10:30–11:00	**Coffee Break**		
11:00–12:30	**Session 2:** Interactive Group Work	Scenario-based Decision Guidance Preparation based on S2S	RIMES

12:30–13:30	**Lunch Break**		
13:30–14:30	**Session 3:** Interactive Group Work	Sectoral requirements for S2S, challenges associated and possible solutions	RIMES
14:30–15:30	**Session 4:** Hands on Demonstration	Climate Services Toolkit and National Livestock Advisory System, Bangladesh	RIMES
15:30-16:00	**Coffee Break**		
16:00–17:00	**Discussions and Experience Sharing**	Identifying priorities, immediate and medium term activities for S2S Application Demo	RIMES

DAY 3 – Operationalising the SAHF CS WG

Time	Session	Details	Lead
09:00–09:15	**Recap**	Reflections and framing of action-planning sessions	RIMES/UKMO
09:15–10:30	**Regional Climate Modeling and Data Systems**	An overview of regional climate modeling platforms/data systems and their application in delivering demand-driven climate services. The session will explore how projections can be tailored to support user needs across key sectors. ● Regional Resilience Data and Analytics Service (**RDAS**) Platform ● Coordinated Regional Climate Downscaling Experiment (**CORDEX**) ● **Open Discussion** Informing priorities for development and collaboration (15 mins)	RIMES/ Technical Experts
10:30–11:00	**Coffee Break**		

11:00-11:30	**Overview of RFCS** **Presentation of the Draft Workplan**	WG Co-Chairs will present the draft CS WG workplan, including proposed activities.	Presented by UKMO WG Co-Chairs
11:30-12:00	**Open Discussion:** Feedback on the CS Workplan	Structured feedback session where all participants and development partners will provide inputs to refine the draft workplan	Facilitated by RIMES/UKMO
12:00-13:00	**Partner Perspectives:** Supporting the SAHF CS WG Priorities	● Presentation on Overview of WISER AP ● Discussion: Other donor and related initiatives that could be leveraged to support the SAHF CS WG priorities	Facilitated by UKMO
13:00–14:00	**Lunch Break**		
14:00-15:30	**Plenary:** Drafting the implementation plan aligning with regional initiatives	● Sharing and consolidating outcomes into a draft implementation plan (2025–2026) ● Synthesizing inputs to inform CS WG work plan and align with regional initiatives	CS WG members/User Sector Representatives/Participants
15:30-16:00	**Coffee Break**		
16:00–16:30	**Finalization of CS WG Workplan & Next Steps**	Confirm actions, governance structure, and coordination mechanisms	CS WG Co-chairs/UKMO/RIMES
16:30–17:00	**Closing Session**	Remarks- WG Co-Chairs Closing Remarks- RIMES & UKMO	

ANNEX 2: PARTICIPANTS LIST

NMHSs and User Sectors

Mr. Quamrul Hassan	BMD
Prof. Dr. Sheikh Sayidul Haque	Directorate General of Health Services (DGHS)
Dr Sardar Muhammad Amanullah	Bangladesh Livestock Research Institute
Mr. Ugyen Chophel	NCHM
Mr. Tshering Wangchen	Department of Agriculture, Ministry of Agriculture and Livestock
Dr. OP Sreejith	IMD
Mr. Ahmed Shabin	Maldives Meteorological Service
Mr. Abdulla Khaleel	Agriculture Department, the Ministry of Agriculture and Animal Welfare (MAAW)
Er. Vijay Kumar Mahto	Department Of Roads (DOR)
Mr. Muhammad Aleem ul Hassan	PMD
Dr. Mirza Waseem Abbas	Punjab Agriculture Depratment, Pakistan
Ms. G.K.Hendawithrana	DoM
Eng.S.M.B.M.Azhar	Department of Irrigation

Development Partners

Dr. Joseph Daron	UKMO
Mr. David Corbelli	UKMO
Dr. T P Sabin	CORDEX, IITM
Mr. Jochen Luther	WMO
Dr Jothiganesh Shanmugasundaram	WFP

Dr. Senaka Basnayake	ADPC
Dr. Sanjay Srivastava	UNESCAP
Dr. Madhurima Sarkar-Swaisgood	UNESCAP
Dr. Leila Salarpour Goodarzi	UNESCAP

RIMES

Dr. Anshul Agarwal	Lead-SAHF
Dr. K J Ramesh	Advisor (Weather and Climate Services)
Mr. Raihanul Haque Khan	Country Lead- Bangladesh
Ms. Kousalya V Kumar	Coordinator-SAHF
Ms. Raissa Jean Ancheta	Communication Specialist
Mr. Mitesh Sawant	Agriculture Specialist
Ms. Virinya Piromrungkit	Administrative Assistant
Mr. Pat Thananchaisirikul	Administrative Assistant
Mr. Jie Qiu	Team Leader for Server and Data Management
Ms. J Elaine Layug	M&E Specialist

Virtual Participants

Dr. Shiromani Jayawardena	RIMES
Mr. Fawad Auobi	AMD
Mrs. Soma Popalzi	AMD
Dr. Tin Mar Htay	DMH
Dr. Sarah Holmes	WMO
Dr. Satyaban B. Ratna	IMD

ANNEX 3: SAHF CLIMATE SERVICES WORKING GROUP DRAFT WORK PLAN

Note: This is an initial working draft and will be revised based on feedback and further analysis

Access the initial document here

South Asia Hydromet Forum: Climate Services Working Group Outline workplan (DRAFT)	
0	***Overall timeline for 'inception' to implementation - (June 2025 - September 2025)***
0.01	Establish working group governance and membership
0.02	Engagement with WG members and key stakeholders
0.03	Produce outline CS WG workplan
0.04	Issue CS inception meeting report and outline workplan
0.05	Produce grant proposal CS (RIMES)
0.06	Consult / engage with regional-national stakeholders to further develop ad refine plan
0.07	Present to, and seek approval from, SAHF EC (Met Office and RIMES)
0.08	Finalise grant and agreements with RIMES (Met Office)
0.09	Organise SAHF CS 'kick-off event'
1	***Implementing a Regional Framework for Climate Services (RFCS)*** *- Formalising the role of the SAHF Climate Services Working Group as a mechanism to implement a RFCS for South Asia, acting to coordinate, facilitate, and strengthen collaboration among regional and national institutions, and to enhance the co-production, tailoring, delivery and use of science-based climate predictions and services.*
1.01	Review guidance from the WMO on establishing a RFCS and map alignment with aims and activities of the SAHF Climate Services Working Group.
1.02	Reach out to key regional organisations (e.g., ICIMOD, Third Pole consortium) to engage with SAHF CS WG and endorse role as RFCS implementing mechanism
1.03	Synthesise learning and progress on NFCS development and implementation across South Asian countries
1.04	Develop a roadmap and action plan that encompasses activities of the SAHF CS WG but extends to longer-term goals (2035?) for climate services in South Asia
1.05	Launch roadmap and action plan for RFCS to broad stakeholder community
2	***DATA ACCESS, USE & SHARING*** *- Strengthening the quality, accessibility and use of historical, seasonal, and longer-term climate data, as well as impact and sector-based datasets for developing climate services*
2.0	**Data rescue and data filling**
2.01	Support initiatives to rescue and digitally archive historical climate datasets
2.02	Support work to fill gaps in station-based historical climate datasets, using satallelite data and novel ML-based methods
2.1	**Enhancing access and use of regional and national climate datasets**
2.11	Support South Asian NMHSs in accessing and using IMDAA reanalysis data (NCMWRF)
2.12	Create national gridded observation datasets for use in climate trends analysis and model validation
2.13	Support access and use of new CORDEX regional climate model datasets
2.2	**Data quality and sharing**
2.21	Promote WMO standards and WCRP principles for climate data and information, ensuring consistency, reliability and accessibility
2.22	Consider / establish data-sharing protocols across RCC and NMHSs for (non-commercially valuable) climate datasets and real-time data exchange for climate monitoring
2.23	Facilitate the development of interoperable, user-friendly digital platforms for climate data dissemination and uptake
3	***CAPACITY BUILDING*** *- Ensuring identification and provision of capacity building and training to support regional-national needs and priorities. Connecting and leveraging relevant platforms, programmes and investment to support delivery* *Supporting sustainability via Train the Trainers (ToT) and trasnferable approaches.*
3.0	**Needs assessment, preparation and development**
3.01	Assessment of training requirements and delivery mechanisms

3.02	Assessment and development of supporting resources: Training materials, guidance, case studies
3.03	Identification of lead organisations and development of Training of Trainers (ToT) approach
3.1	**Delivery of capacity building and training priorities**
3.11	Training of stakeholders/forecasters etc. in access and use of products and services
3.12	Regional training of trainers (1-2 NMHSs from each country)
3.13	Identification of capacity enhancement focal point(s) from each NMHS and RIMES for training of trainers
3.14	Seasonal: Training on the tools used for generating seasonal outlooks regular pre-COF sessions.
3.15	Seasonal: Capacity building for user and related organisations
3.16	Climate: Capacity building for climate projections and services development (producers)
3.17	Climate: Capacity building for climate projections and services use and application (users)
3.18	Climate: Capacity building for climate projections and services (orientation for policy makers)
3.19	Development and rollout of participatory capacity building activities
4	***TOOLS AND DECISION SUPPORT SYSTEM DEVELOPMENT** - Ensuring awareness, access, development and use of available tools and support systems*
4.01	Identification, cataloging of available tools and decisions support systems
4.02	Platform / access development: Mechanisms to provide access, guidance to relevant tools and decisions support systems
4.03	Enhancement, development of specific tools / decision support systems
4.04	Ensure regional mechansims to support knowledge sharing, resource sharing, cross learning
4.05	Pilot project: co-development of seamless climate service for priority sector(s) to demonstrate use of near-term, S2S and longer-term climate information

5	***USER ENGAGEMENT** - Strengthening forums for provider, intermediary and user interactions, achieving scalability of services to reach diverse and marginalised users, and ensuring mechanisms for feedback and continual improvement in climate services across the region*
5.01	Support and enhance the SASCOF CSUF to broaden user base, promote interactions and dialogue, and co-produce impact-based seasonal outooks
5.02	Establish a SAHF supported Regional Climate-Agriculture Platform under for real-time advisory co-creation and adaptation R&D
5.03	Design and initiate regular dialogues and engagement opportunities amongst WG with key user sertors and organisations (governments, academia, industry and civil society)
5.04	Promote scaling of climate services and uptake/tailoring for marginalised and vulnerable communities
6	***Enable policy and institutionalisation (iterative throughout process)*** *Ensuring alignment (and enabling) of regional-national ppolicies and processes.* *Ensuring activities inform regional-national policy and processes to support sustainability*
6.01	Development of learning and knowledge sharing mechansims
6.02	Development / synthesis of evidence to support planners and decision makers
6.03	Support, inform regional-national policies and processes
6.04	Identify opportunities for wider dissemination and engagement with work (e.g. Global-Regional Heat Health Networks, ICCS
6.05	Identify opportunities for wider dissemination and engagement (e.g. Heat Health Network, Dialogue Platforms etc.)
6.06	Support regional climate services 'conference/s'
7	***Monitoring and Evaluation:***
7.01	

ANNEX 4: SUMMARY OF COUNTRY PRESENTATIONS

Afghanistan

Current Status of Climate Services:

AMD utilizes NASA products, CMC-1 maps, and extracts from the CPT model, as well as Focus 2 from RIMES, for seasonal forecast production. More information, including seasonal forecasts, is available on the AMD website in Pashto, Dari, and English. Their seasonal forecasts are not based on AMD-hosted models but rather use external models to provide an idea for the next three months.

Forecast Products and Delivery:

AMD produces seasonal forecasts for precipitation and temperature. For June-August 2025, mean temperature variation is expected to be 0.5-1°C in the north, east, northeast, southeast, and parts of the south, and 1-2°C in the southwest, west, northeast, and some central parts. Precipitation for the same period is expected to be normal for most areas, with some parts of the north, northeast, and east being normal, and parts of the south and southwest being above normal. The IRI model, however, suggests normal precipitation, with some northern, northeastern, and eastern parts below normal, and southern and southwestern parts above normal.

AMD has observed extreme weather events, including monsoon rains in April 2023, which caused significant rainfall and snowfall across various regions. They also issued warnings for flash floods in Baghlan province in May 2024, which did occur and affected many areas. Heatwaves are also a concern, with temperatures exceeding 40°C in May and June 2023, particularly in the southeast and west, with Farah recording 49.4°C in June 2003.

Tools, Platforms, and Data Usage:

AMD uses the CPT model and regional data sources like SASCOF products, along with observational data from its meteorological stations.

Capacity Gaps:

AMD has approximately 56 active and semi-active meteorological stations but lacks its own models for predicting climate situations and seasonal forecasts accurately. They primarily rely on CPT. A significant data gap exists from 1977 to 2005 across all stations.

AMD identifies several areas where regional cooperation and training are needed:

- Data gap filling and data management.
- Seasonal forecast models and training.
- Climate production and tools hosted by AMD itself.

Bangladesh

Current Status of Climate Services:

The Bangladesh Meteorological Department (BMD) faces limitations in its current climate services, primarily providing historical data upon request. While an expert group meets monthly to produce one-month and three-month "Outlook" forecasts, which are shared with the flood forecasting and warning center and agriculture, there are limited products shared with users.

BMD is undertaking experimental co-production for four sectors: agriculture, health, water resources, and livestock, with assistance from RIMES. They have been holding regular Climate Outlook Forums since 2010, with two annually (before monsoon and before winter). Recently, they started an additional forum outside Dhaka. User interaction is regular for the four co-production sectors.

Despite the challenges of producing climate products for a small country, BMD, with RIMES' help, is developing monthly and seasonal forecasts (rainfall, maximum, and minimum temperature) for these four sectors. Sub-seasonal forecasts are also being produced with the Department of Agriculture. A World Bank project is enabling weekly forecasts (week one, week two, and week three plus four) primarily for the Department of Agriculture, though these are experimental and use outputs from only three models. Advisories for the four sectors are also being produced with RIMES' help.

Forecast Products and Delivery:

Since 2011, BMD has collaborated with the Norwegian Meteorological Institute, publishing two reports on climate data from 1981-2010 and 1991-2020, which are available on their website. They are also working on climate projections using NASA NextGen data and 35 model outputs, with a report on this expected soon. This projection indicates a possibility of heatwaves occurring throughout the year in Bangladesh under the worst-case scenario (SSP 8.5).

Tools, Platforms, and Data Usage:

BMD utilizes various tools, including CPT (with limitations regarding ensemble products and data dependency on IRI), and Py-CPT (which allows ensemble production while still using CPT's back-end). They also use XCAST, an open-source software that allows the use of outputs from other centers. Recently, they've started using forecast guidance tools from the Tokyo Climate Center of JMA for rainfall and temperature. A Python platform has also been developed for sub-seasonal forecasts with the Department of Agriculture through a World Bank project.

BMD relies on climate products from global producing centers (WMO designated), Copernicus, North American Multimodal Ensemble, IRI, Columbia University, and the epic climate center. SASCOP is another data source.

Capacity Gaps:

Key gaps identified include data availability issues with CPT and PyCPT, the need for a common data format or platform for easier use of different model outputs, capacity building within BMD , and improved user engagement and communication.

Bhutan

Current Status of Climate Services:

NCHM operates under the Ministry of Energy and Natural Resources and is guided by a technical advisory committee comprising different user sectors. All NCHM plans and programs must align with Bhutan's "gross national happiness" philosophy.

NCHM holds periodic NCOFs annually, following regional Seasonal Climate Outlook Forums. Information is provided to sectoral ministries and departments (e.g., agriculture, forestry) rather than directly to farmers, with the expectation that these sectors will interpret the information at the grassroots level. A significant challenge is user trust, as forecast inaccuracies can lead to skepticism.

Uniquely, NCHM integrates indigenous practices, such as inviting a monk astrologer from the Buddhist School of Astrology to present an outlook for the entire year at the NCOF. This astrological outlook, often portrayed through symbolic images like an ox with various colored features, is simplified to convey information about rainfall, temperature, heat, windstorms, and even risks to livestock. The primary advantage of this integration is maintaining user faith, especially among deeply religious rural populations, even if the forecasts are not always accurate. Research with the University of Oxford is exploring the origins of these astrological calculations. NCHM views this indigenous tool as more powerful than scientific tools like CPT because it helps maintain public trust.

Forecast Products and Delivery:

NCHM provides general climate services, including historical data, climate reports, and summaries. There is a growing demand for high-resolution, downscaled, and bias-corrected climate change information (1-2 km resolution) from various sectors for impact assessment and climate-informed planning. While they attend SASCOF to acquire seasonal outlook products, NCHM currently does not provide sub-seasonal or monthly forecasts.

Dissemination primarily occurs through their website, upon request, and at forums. Working with sectors and establishing strong partnerships or MOUs has proven more effective than direct engagement with end-users. They utilize systems like ADSS (with RIMES and World Bank support) to provide information based on short- and medium-range forecasts, but seasonal forecast integration requires significant customization.

Tools, Platforms, and Data Usage:

NCHM uses a Climate Service Toolkit developed with RIMES, though it has limitations. They also use CPT, acknowledging its limitations such as relying on a single data source and inability to produce ensembles.

Capacity Gaps:

Overall, Bhutan faces low capacity in observation, modeling infrastructure, short-range forecasts, tailored services, and integrated services. Key challenges include a lack of technical capacity, skills, infrastructure, and a robust data management system. While they receive regional products from IMD and NCNWRF, access to global producing centers (e.g., UK Met Office, ECMWF) is limited, hindering the operationalization of S2S forecasting.

India

Current Status of Climate Services:

IMD offers sectoral applications of weather and climate services across various domains, including disaster management, agriculture, water, and health, and is expanding into sectors like finance (e.g., MOU with the Reserve Bank of India). They continuously monitor observed climate on seasonal, monthly, and annual bases, including mean surface temperature and drought indicators. IMD issues long-range forecasts for important seasons (winter, heatwave, northeast monsoon) and monthly forecasts using multimodal ensemble techniques. They also contribute to the "State of the Climate in Asia" report in collaboration with WMO and produce annual climate statements for the country, states, and even districts. Regular climate monitoring and forecast bulletins are issued. As a regional climate center, IMD regularly conducts SASCOF and Climate Service User Forums, issuing monthly rainfall and temperature forecasts for the South Asia region.

Forecast Products and Delivery:

IMD employs a seamless forecasting system, integrating seasonal, extended-range, medium-range, short-range, and nowcasting. Forecasts for cold waves, heatwaves, and monsoon rainfall are issued seasonally and monthly. Weekly extended-range forecasts for rainfall (observed, forecasted, and anomalies) are also provided. IMD regularly issues forecast products for South Asian countries. They also produce monthly ENSO and IOD bulletins, providing observed characteristics and probabilistic plume forecasts for up to eight months ahead. All forecasts are disseminated through the IMD headquarters, IMD Pune, and RCC Pune websites.

A dedicated Climate Application and User Interface group develops operational products for agriculture, hydrology, and health.

- **Agriculture:** Uses SPI, SPR, and RIDT anomaly index for drought monitoring. Extended-range forecasts also predict SPI for the coming week.

- **Hydrology:** Monitors sub-basin rainfall across India based on observed data and generates rainfall anomaly forecasts at the sub-basin level using extended-range forecasts.

- **Health:** Issues weekly "climate information for health" bulletins, highlighting districts at risk for vector-borne diseases like malaria and dengue, based on temperature transmission windows from extended-range forecasts.

- **Disaster Risk Reduction:** IMD has developed a hazard and vulnerability atlas for each district, covering 14 major hazards (e.g., drought, cold waves, dust storms, cyclones)

based on 45 years of data. This helps in risk planning and mitigation for events like heatwaves and extreme rainfall. All these products are freely available on their website.

Tools, Platforms, and Data Usage:

IMD uses a statistical model and a recently developed multimodal ensemble system for seasonal forecasts, also utilized for SASCOF. They employ QGIS and specific Python packages to tailor forecast products for agriculture, water resources, and health sectors. All information is available on the IMD headquarters website, the dedicated climate services website at Pune, and the RCC Pune website.

Capacity Gaps:

While significant achievements have been made, IMD recognizes scope for further advancement in climate services. They are implementing a National Framework for Climate Services (NFCS) in collaboration with various agencies, organizing stakeholder consultation workshops to identify gaps and develop strategies. These workshops involve officials from state governments, central ministries, research organizations, academic institutes, professional bodies, media, and NGOs. The workshop statement developed by IMD has been used as a template for WMO/UK Met Office's updated NFCS implementation guidelines. Establishing NFCS requires multi-institutional collaboration across various ministries (e.g., Health, Disaster Management, Energy, Water Resources, Agriculture). IMD aims for co-development and co-delivery of services, believing that different ministries working together will improve climate services.

Maldives

Current Status of Climate Services:

Climate services are a very recent development at MMS; efforts were primarily focused on weather forecasting until this year when a climate section, staffed by one person, was established. Despite this limited staffing, some climate services have been delivered through the parallel efforts of weather forecasters and observers. This poses challenges for work continuity due to multiple individuals handling tasks.

MMS has conducted nine Monsoon Forums since 2012, with the most recent one in April of the current year. These forums are driven by funding availability, which often leads to inconsistent scheduling. RIMES has provided significant support for these forums. MMS aims to keep the forums regional, with a focus on the southern atolls due to the monsoon's onset in that area. They strive for a pre-monsoon platform in April, which serves as their primary outreach avenue to the atoll islands.

MMS participates in SARS-CoV and issues Rainfall and Temperature Outlooks for June, July, August, and September (JJAS) in both English and their local language. A challenge arises because their peak rainy season is in May, meaning the JJAS outlook is not available for their pre-monsoon forum in April. Other challenges include the minimal spatial resolution on maps, making it difficult to explain to sectoral users, and translating climate terminology into the local language.

Forecast Products and Delivery:

Monthly forecasts are issued using CPT and global center outputs, with verification against previous month observations and climatology, and uploaded to their website. However, user engagement is an area needing improvement, as simply uploading information doesn't guarantee public access or awareness.

Currently, MMS does not have specific climate-based advisories or applications. They did trial a two-week dry season forecast product to notify the public about upcoming rainfall episodes for rainwater harvesting, particularly during January, February, and March when some islands face water shortages. This service was delivered via a mobile app, sending notifications to areas expecting sufficient rainfall. However, the mobile app went out of service due to subscription issues, and efforts are underway to restore it.

Tools, Platforms, and Data Usage:

MMS lacks a specific climate service tool but is working with RIMES to develop DSS platforms, with interest from the tourism sector. They have five long-term observation monitoring stations with 30 years of data, providing opportunities for analysis and research, especially for validating gridded datasets. MMS is also researching their indigenous annual weather calendar to re-synchronize it with current observations.

MMS has an in-house high-performance computer primarily for implementing ocean and wave models, and running the WRF model, with potential for further in-house modeling work.

Capacity Gaps:

Challenges include a lack of local expertise in modeling and research, funding support for contextualization and user engagement, and a language gap between weather science and user sectors like agriculture, tourism, and NDMA.

Myanmar

Current Status of Climate Services:

DMH issues general weather outlooks and seasonal forecasts twice a year for the summer and northeast monsoon seasons, primarily through their Monsoon Forum. While they previously held regional forums, they now only conduct national-level forums. DMH also issues climate projections based on two scenarios (RCP 8.5 high emission and RCP 4.5 intermediate emission) using the same claim tools and War Claim Tool for baseline data, projecting up to 2100. These projections are simplified and need updating with synthesis data. The climate projection outputs are included in their S&C report and distributed to related sectors like water, energy, and agriculture. DMH cooperates with various sectors, including agriculture, water, health, and energy, by inviting them to the National Monsoon Forum where seasonal forecasts are provided. DMH also participates in SACPORT and ASEAN CORE to gather and share forecast information. Feedback and suggestions from these forums are collected to improve forecast accuracy, enhance staff awareness, and promote climate change adaptation.

Forecast Products and Delivery:

DHM uses regional outlooks from APEN, Bua Muli Center, and Climate Prediction Center, as well as S2S forecast outputs, to issue their seasonal and monthly forecasts. They also use CPT tools, incorporating both website data and their historical data.

Myanmar experienced record high temperatures in 2023-2024, with one station recording 48.2°C, which was also reported as the highest in the South Asia region during that period. The average maximum temperature during 2023-2024 was 32.7°C. Due to the strong El Niño event, the Myanmar Drought Monitoring Center issues drought information based on rainfall anomaly, SPN, and IDN methods. Significant drought was observed in the central dry zone, upper Myanmar, western parts, and some southern stations from May to October 2024.

DMH issues specific advisories for the agriculture, water, and health sectors.

- Agriculture: Provides decade-long forecasts three times a month. Farmers use these forecasts for actions like adjusting rice access and preparing for mid and late monsoon flood disasters.

- Water: Issues flood bulletins and warnings, providing advisories for irrigation and water utilization management. They use forecasts for dam and sub-area calculations, flood management, dam water storage, outflow, safety precautions, and maintenance plans for flood control operations.

- Health: Issues general information to the health sector, which uses maximum temperature forecasts to prepare for heat stroke and issue heat index warnings. They also hold conferences for early warning, alerts, and response systems.

- Disaster Management: DMH's forecasts inform national-level disaster management committees, which prepare for and respond to disasters like floods and storms. They also cooperate with the Disaster Management Department to conduct training and provide suggestions for disaster management. Information is disseminated through social media, TV, radio, newspapers, and websites.

Tools, Platforms, and Data Usage:

DMH uses CPT to generate climate scenarios for the clean tool. They plan to implement a data portal and mobile application system for climate services. They utilize CODES data for climate change projections and sometimes contact local governments for ground data in emergency situations where direct data collection is difficult.

Capacity Gaps:

DMH has extensive capacity and gaps in climate services. They require capacity building at both technical and institutional levels. Challenges include updating climate scenarios with CMSIS data due to a lack of donor partners, pilot projects, and training for new generations of staff. Real-time data sharing is a major challenge due to current conditions, limiting them to DDS data sharing. DMH has not received specific training from the DSSF working group, only marine training.

Sri Lanka

Current Status of Climate Services:

DoM issues 3-day, 9-day, weekly, monthly, and seasonal (three-month) forecasts, as well as climate projections. They provide sector-specific advisories in collaboration with agriculture, disaster management, and water resources agencies. Collaborating institutions include the Disaster Management Center, Ministry of Irrigation and Water Resources, various INGOs (IWMI, WFP, FAO), Department of Agriculture, Ceylon Electricity Board, NBRO, Plantation Ministry, and university research institutes. A National Climate Service Committee is in its initial stage, and various interagency meetings and panels contribute to climate services.

Sri Lanka holds two National Monsoon Forums annually for the Southwest and Northeast Monsoons, involving sectoral users (agriculture, water, disaster risk reduction, health, power), government agencies, and INGOs. These forums present seasonal outlooks and facilitate discussions and feedback. Sub-national and sectoral forums are also piloted with WFP support. The National Monsoon Forum began in 2008 with RIMES' support until 2023. Before monsoon forums, DoM conducts needs assessments, historical data analysis, and model output analysis based on regional forums like SASCOF. After forums, they disseminate advisories, collect feedback, and monitor understanding and application, also attending preparedness meetings at provincial and district levels.

Forecast Products and Delivery:

DoM provides national forecasts for rainfall and temperature, with temperature being less popular in Sri Lanka. They also forecast onset and cessation dates. Monthly forecasts include maximum and minimum temperatures, and rainfall indications (below normal, normal, above normal). Seasonal forecasts are issued for three-month periods for sectoral divisions. Sub-seasonal outlooks include 9-day, weekly, and monthly forecasts, with ECMWF's 9-day forecast being popular. DoM monitors drought using the SPI (Standardized Precipitation Index) for 3, 6, 9, 12, and 18-month periods. They also produce dynamic and statistical climate projections.

Delivery channels include web dashboards, the DoM portal, a mobile app (ANAWAKI web app), web GIS, WhatsApp, Facebook groups, other social media, email, and a hotline.

DoM provides tailored advisories for agriculture, water resources, disaster management, health, and energy sectors.

- Agriculture: DoM attends monthly meetings to provide outlooks for the agriculture sector, which then produces information bulletins. They also issue weekly Agromet Bulletins for the next four weeks and monthly bulletins, which inform crop calendar adjustments and pest/disease risk alerts.

- Water Resources: DoM participates in monthly meetings with water management authorities (like Mahaweli Authority) to provide forecasts for managing reservoir levels for drinking, farming, and hydropower generation.

- Disaster Management: DoM provides forecasts and climate predictions for flood, inundation, landslides, and cyclone strike probabilities to the Disaster Management Center. This aids in pre-positioning relief and altering reservoir release schedules.

- Health: DoM gives climate-related advisories that inform weekly dengue/malaria forecasts and heat threat indices. They also issue heat weather advisories and warnings with health sector involvement, providing instructions to the public.

- Energy: Hydropower generation outlooks are provided to the energy sector for planning.

Applications in decision-making include shifting paddy sowing calendars based on seasonal outlooks, pre-positioning relief items by disaster management centers, altering reservoir release schedules, heat action plans (e.g., early school hour changes during heat weather events), and food security projects. Climate smart agriculture policies are informed by seasonal trends and national adaptation plans.

Tools, Platforms, and Data Usage:

DoM uses a Climate Portal (PRISM) supported by WFP, featuring interactive maps, time series, and NetCDF download facilities. They also utilize their department website and the Disaster Information Management System, which includes risk layers and trigger thresholds. In-house toolkits include CPT, Focus, XCAST, and multimodal ensembles.

For data sources, DoM uses and SASCOF Consensus Outlooks as first guesses for national seasonal forecasts. They also leverage WMO GPCS Model Guidance, CORDEX for climate change projections, NASA NextGEN, CMIP66 data, APCC, NMME probabilistic hindcast data, Climate Prediction Center, NCEP, Government of Australia (BOM), and IRI for climate driver outlooks.

Local observations and indigenous knowledge are integrated by blending global products with ground observations, validated in monsoon forums, and translated into sector-specific advisories. Examples of indigenous indicators include weaver birds building nests in lower branches (predicting drier seasons) or higher branches (predicting rainy/flood seasons), and the abundance of wood apple flowers indicating good upcoming rain.

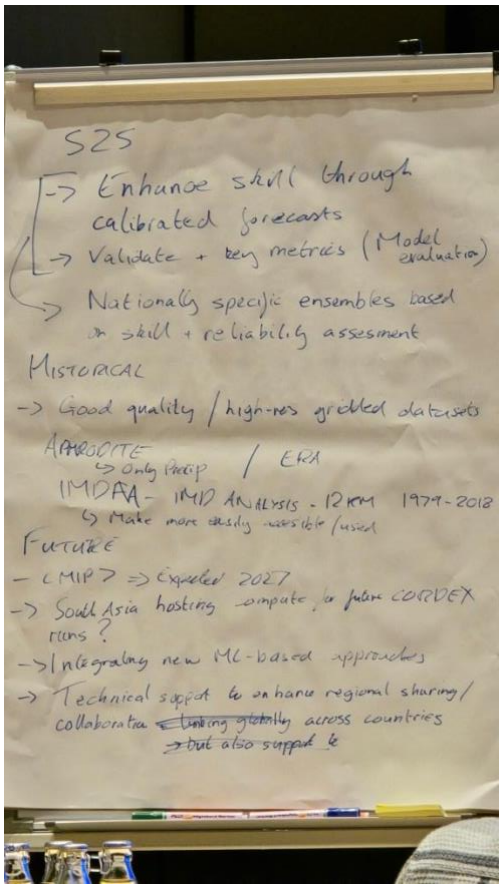
Capacity Gaps:

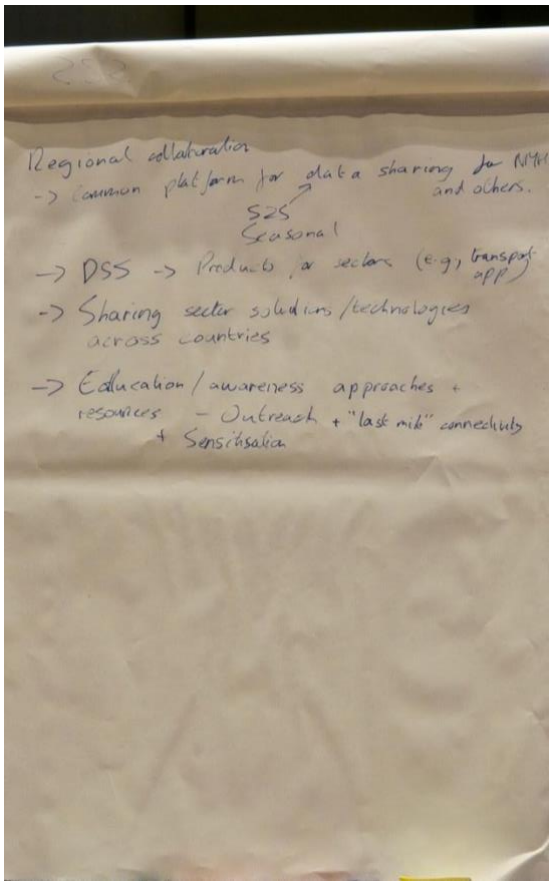
DoM has skilled meteorologists and research officers trained in seasonal forecasting, operating tools and global models, and expanding GIS and Python-based workflows. They also maintain a 150-database. Institutional coordination exists through regular meetings with DMC, Department of Agriculture, Irrigation, and Ministry of Health, along with national monsoon forums and user meetings.

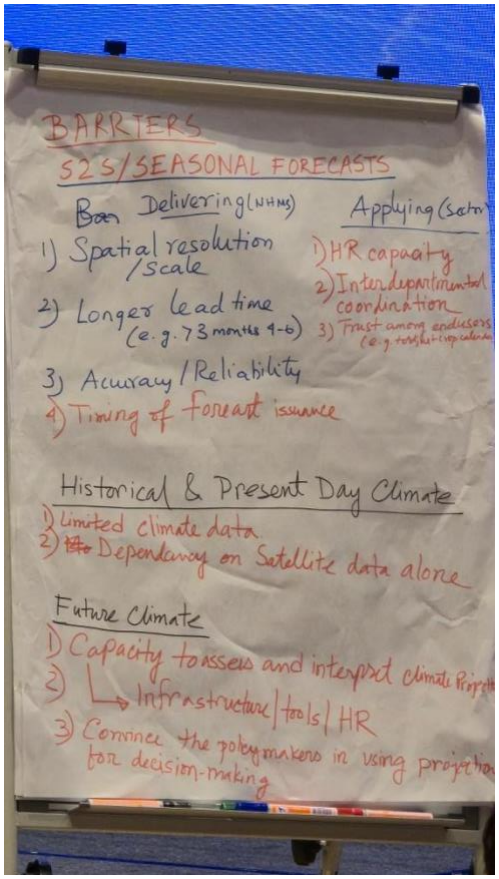
Technical gaps include limited local downscaling and impact-based modeling capacity, inadequate high-resolution gridded datasets, and insufficient climate data infrastructure (archive systems, APIs). Challenges in user engagement and communication stem from the need for better interpretation in sector-specific language, limited feedback mechanisms from end-users, and co-production with local planners. Funding and sustainability are also issues, with projects often donor-driven and short-term, and a lack of budget for operational climate services and training, exacerbated by limited staff capacity due to recruitment halts amidst economic crisis.

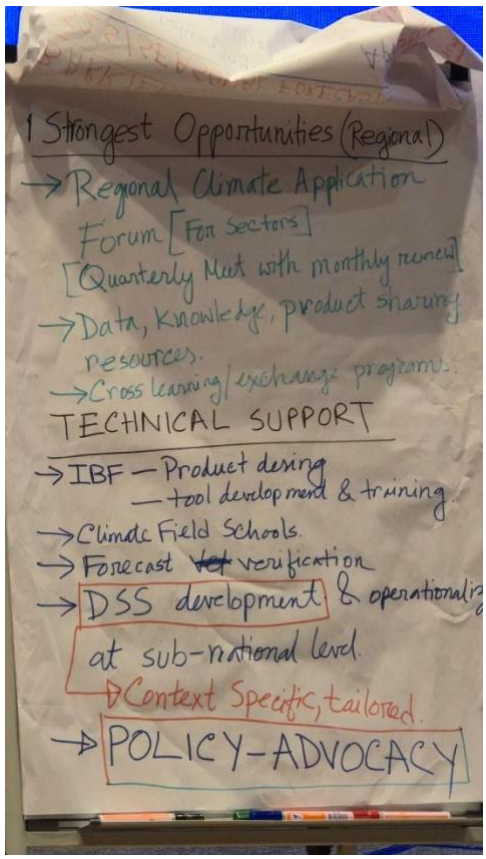
ANNEX 5: INTERACTIVE DISCUSSION – WORKSHOP OUTPUTS

24 June 2025: Regional Insights and Priorities






BARRIERS
S2S/SEASONAL FORECASTS
Delivering (NHMS)
Applying (Satm
1) Spatial resolution /scale
2) Longer lead time (e.g. 3 months 4-6)
3) Accuracy / Reliability
4) Timing of foreast issuance
1) HR capacity
2) Inter-departmental coordination
3) Trust among endusers
Historical & Present Day Climate
1) Limited climate data
2) Dependency on Satellite data alone
Future Climate
1) Capacity to assess and interpret climate
2) Infrastructure | tools | HR
3) Convince the policymakers in using projection for decision-making


1 Strongest Opportunities (Regional)
→ Regional Climate Application Forum [For Sectors]
[Quarterly Meet with monthly review]
→ Data, Knowledge, product sharing resources.
→ Cross learning / exchange programs.
TECHNICAL SUPPORT
→ IBF — Product desing — tool development & training.
→ Climate Field Schools.
→ Forecast verification
→ DSS development & operationaliz
at sub-national level.
Context Specific, tailored.
→ POLICY-ADVOCACY

Regional Insights and Priorities

(1) Key barriers (S2S, Historical, present and future climate)

S2S forecast – the uncertainty needs to be translated to users

MJO/ISO – research on the impact of S2S (useful, but more research is required),

Seasonal, monthly, annual, decadal, climate change – All scales forecast to the users (uniform format) – different organisations are giving different formats

Impact of different climate drivers

Data gaps need to be addressed (obstacle of understanding climate variability and change)

Extreme climate indices need to be used for stakeholders

Communicating seasonal forecast and climate change report – effectively communicated to user sectors

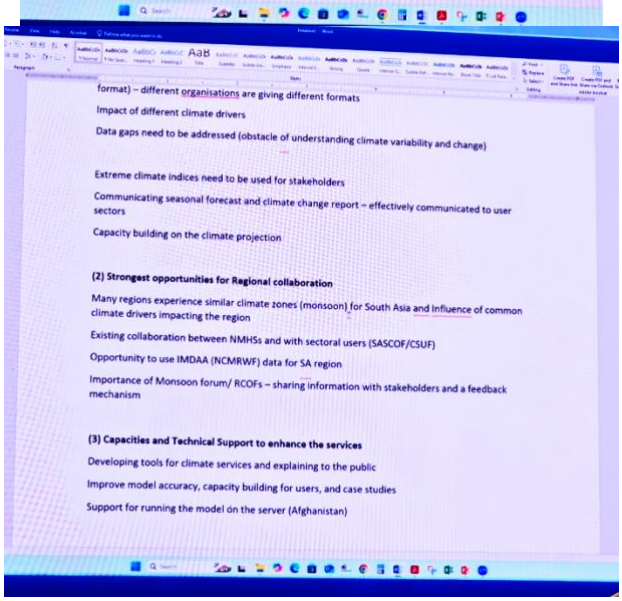
Capacity building on the climate projection

(2) Strongest opportunities for Regional collaboration

Many regions experience similar climate zones (monsoon) for South Asia and Influence of common climate drivers impacting the region

Existing collaboration between NMHSs and with sectoral users (SASCOF/CSUF)

Opportunity to use IMDAA (NCMRWF) data for SA region


format) – different organisations are giving different formats

Impact of different climate drivers

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Capacity building on the climate projection

(2) Strongest opportunities for Regional collaboration

Many regions experience similar climate zones (monsoon) for South Asia and Influence of common climate drivers impacting the region

Existing collaboration between NMHSs and with sectoral users (SASCOF/CSUF)

Opportunity to use IMDAA (NCMRWF) data for SA region

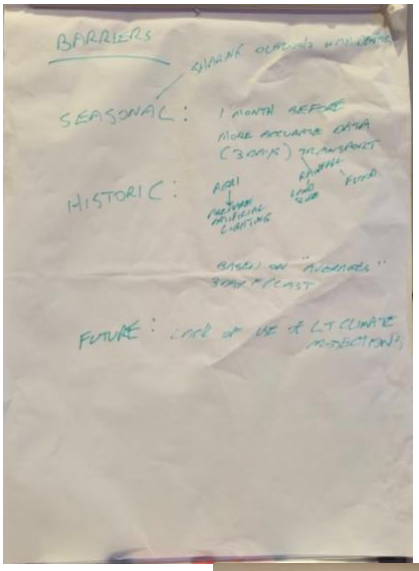
Importance of Monsoon forum/ RCOFs – sharing information with stakeholders and a feedback mechanism

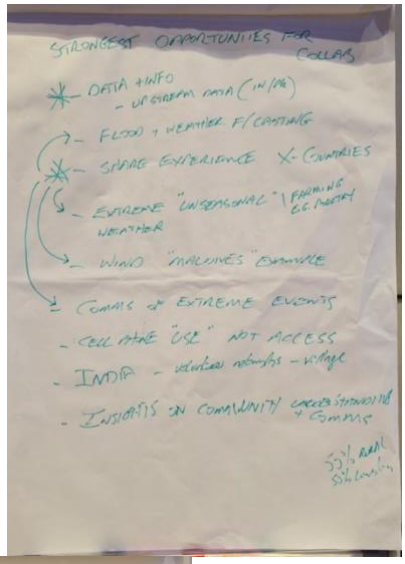
(3) Capacities and Technical Support to enhance the services

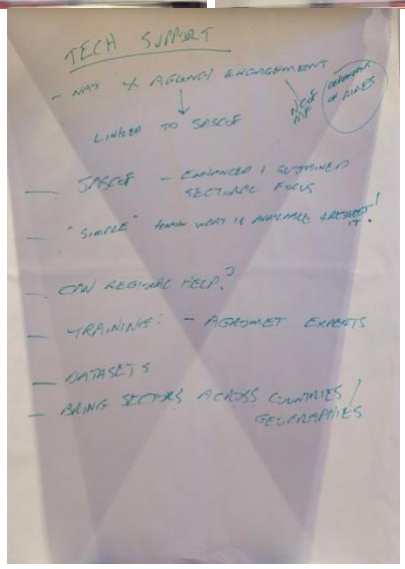
Developing tools for climate services and explaining to the public

Improve model accuracy, capacity building for users, and case studies

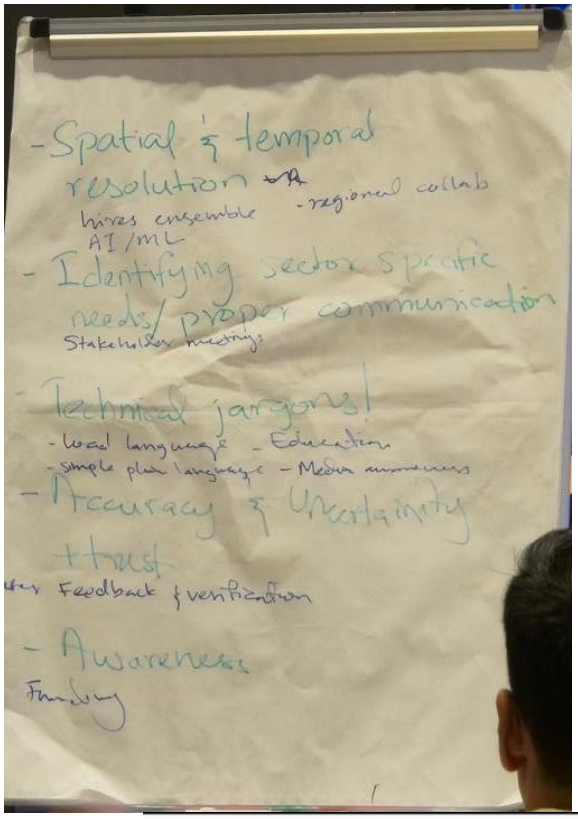
Support for running the model on the server (Afghanistan)

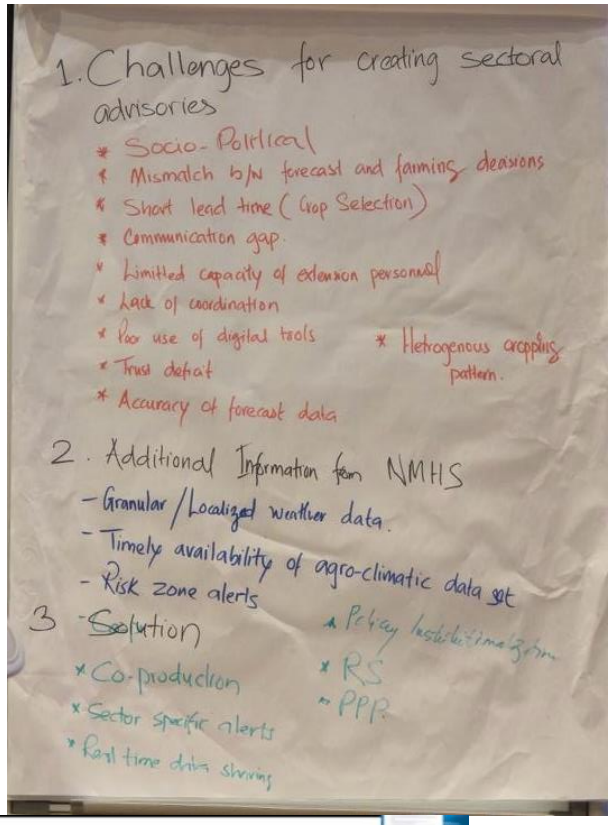

BARRIERS
SEASONAL:
1 MONTH BEFORE
HISTORIC:
FUTURE:

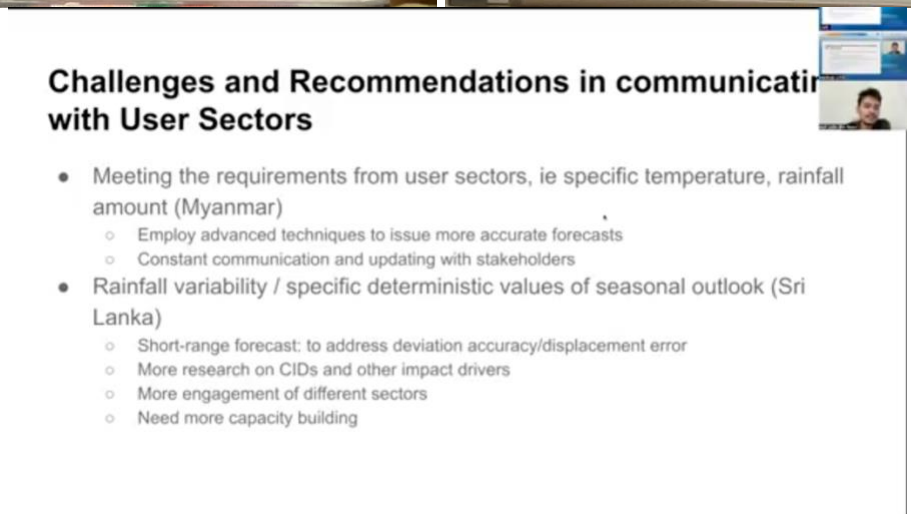

STRONGEST OPPORTUNITIES FOR
DATA + INFO
- UPSTREAM DATA (IN/PK)
- FLOOD + WEATHER F/CASTING
- SAVAGE EXPERIENCE X-COUNTRIES
- EXTREME "UNISEASONAL" | FARMING
WEATHER
- WIND "MACHINES" EXAMPLE
- COMMS OF EXTREME EVENTS
- CELL PHONE "USE" NOT ACCESS
- INDIA - VILLAGE
- INSIGHTS ON COMMUNITY/


TECH SUPPORT
- MET + AGENCY ENGAGEMENT
LINKED TO SASCE
SASCE - ENHANCED | SUSTAINED
SECTORAL FOCUS
"SIMPLE"
CAN REGIONAL HELP?
TRAINING: - AGROMET EXPERTS
DATASETS
BRING SECTORS ACROSS COUNTRIES/
GEOGRAPHIES

25 June 2025: Challenges and Recommendations in Communicating with User Sectors





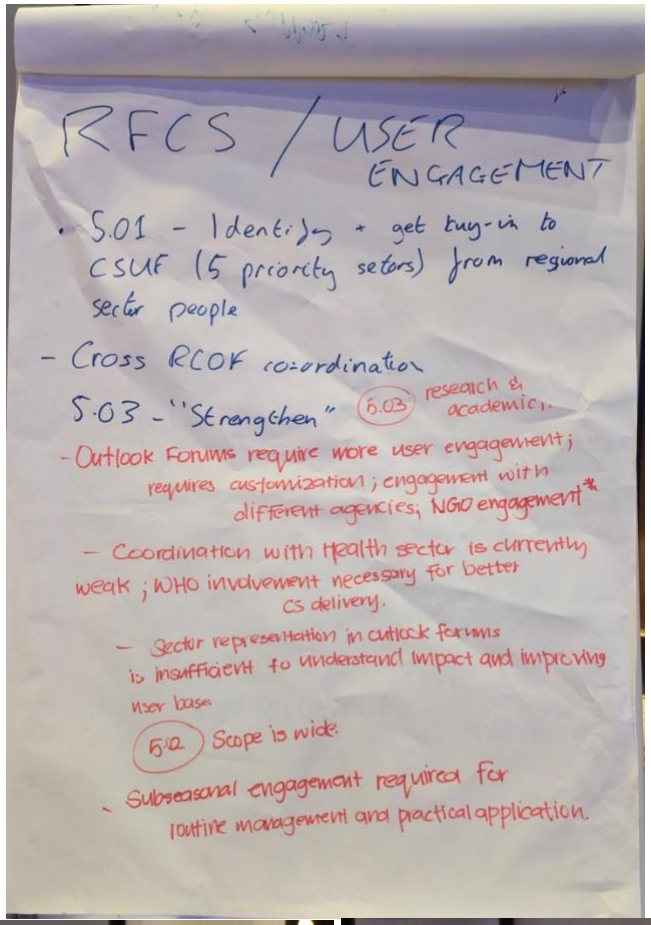


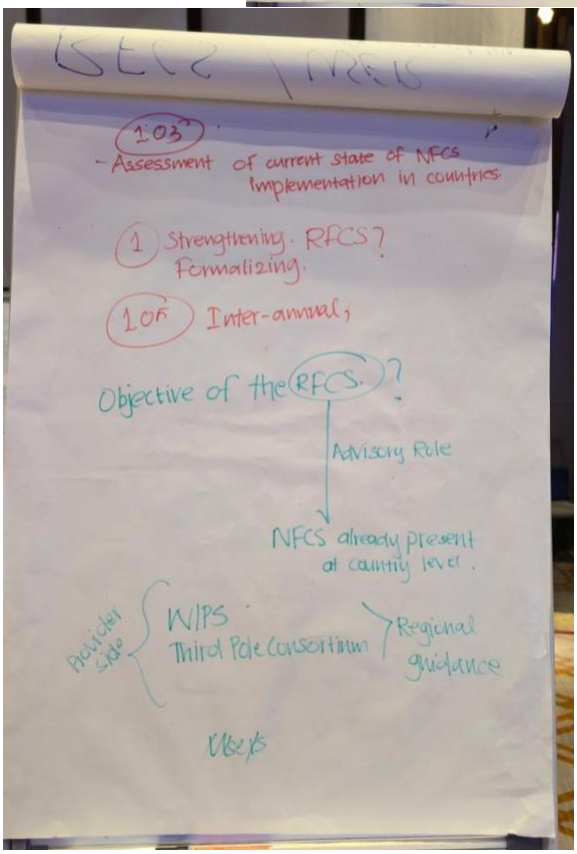
Challenges and Recommendations in communicati with User Sectors

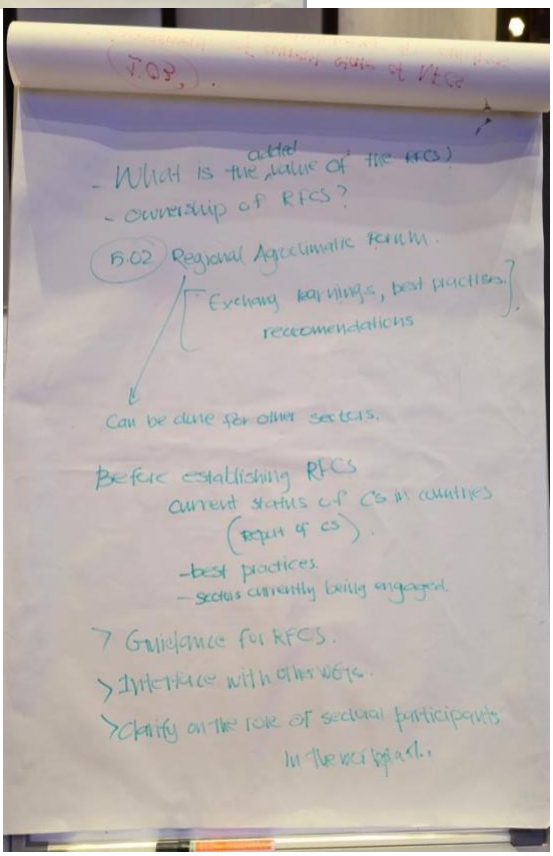
- Meeting the requirements from user sectors, ie specific temperature, rainfall amount (Myanmar)
  - Employ advanced techniques to issue more accurate forecasts
  - Constant communication and updating with stakeholders
- Rainfall variability / specific deterministic values of seasonal outlook (Sri Lanka)
  - Short-range forecast: to address deviation accuracy/displacement error
  - More research on CIDs and other impact drivers
  - More engagement of different sectors
  - Need more capacity building

26 June 2025: Insights to the Draft Workplan

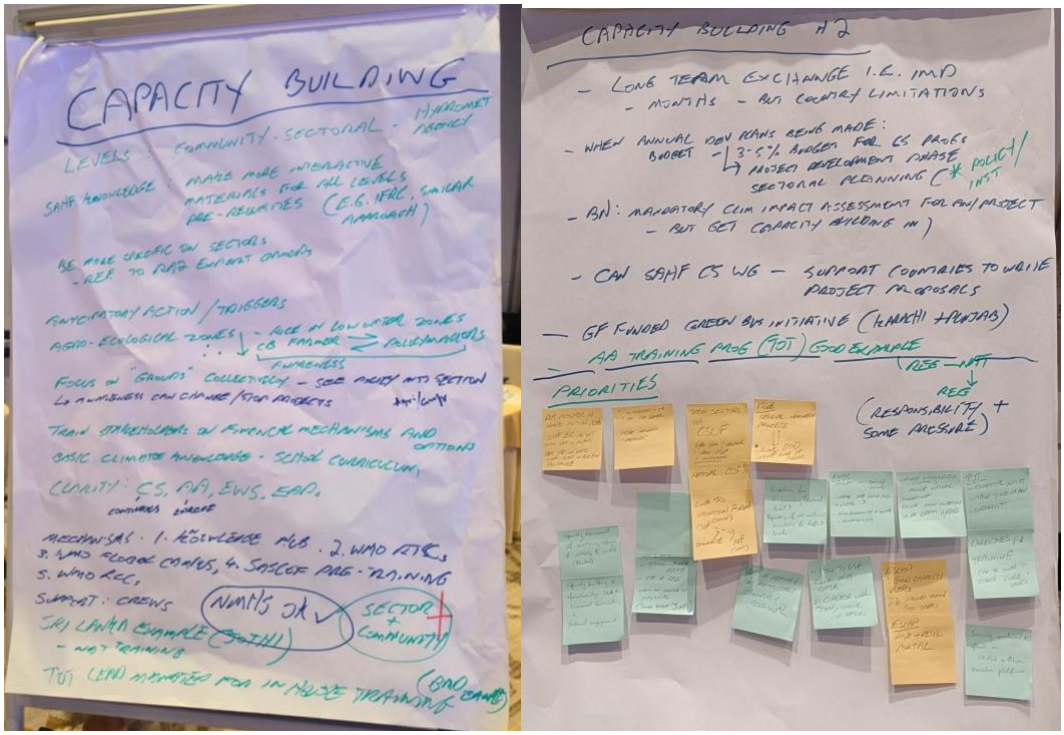
RFCS and User Engagement



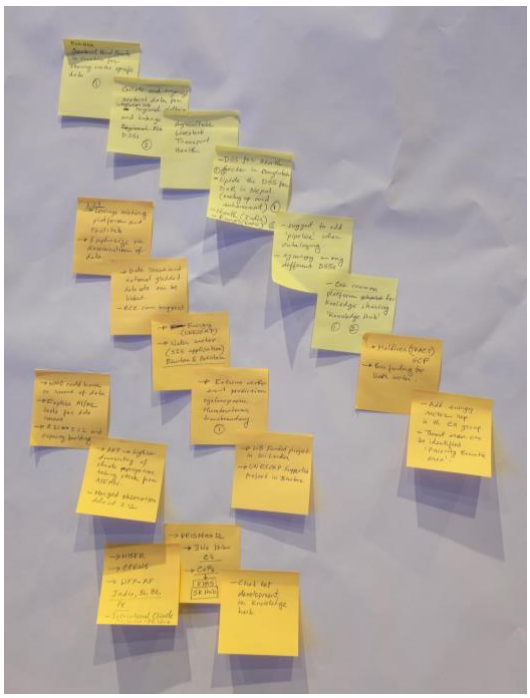




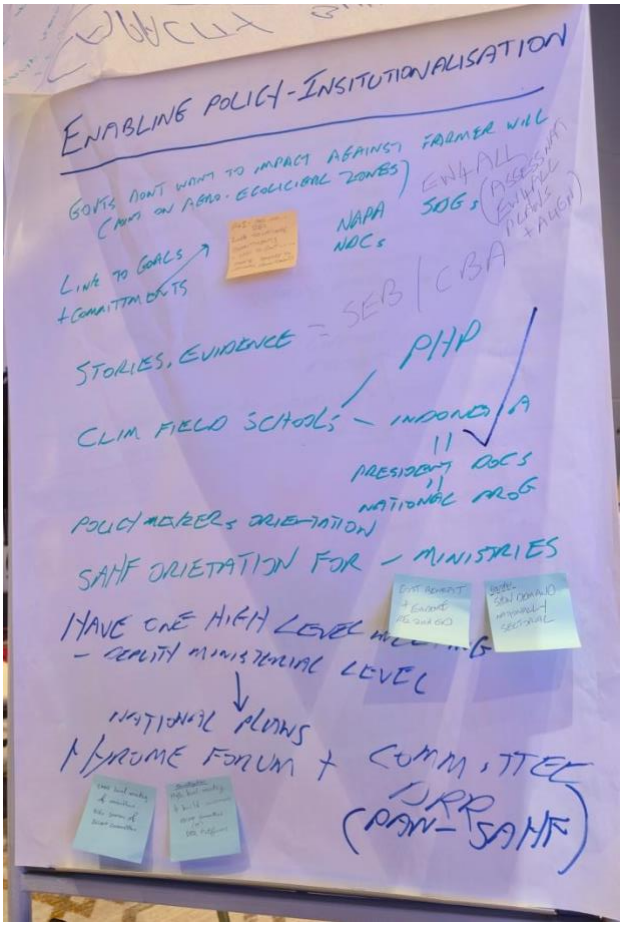
Capacity Building



Data and Decision Support Systems



Policy


ENABLING POLICY-INSITUTIONALISATION
FARMER WILL
NAPA
NDCs
PHP
SAHF ORIETATION FOR - MINISTRIES
NATIONAL ALIGNS