SAHF KNOWLEDGE HUB AND DATA EXCHANGE PLATFORM TRAINING WORKSHOP

27 February 2025| Bangkok, Thailand

OUTCOME REPORT

SOUTH ASIA HYDROMET FORUM

BACKGROUND

The SAHF Knowledge Hub (SKHub) and Data Exchange (DataEx) Platform Training Workshop, held on 27 February 2025 in Bangkok, Thailand, was a key initiative aimed at strengthening the forecasting and data management capabilities of National Meteorological and Hydrological Services (NMHSs) across South Asia. Organized under the South Asia Hydromet Forum (SAHF) – Climate Adaptation and Resilience (CARE) for South Asia, this workshop brought together meteorologists, climatologists, IT professionals, and researchers from NMHS and sectoral institutions to enhance their understanding and practical use of two critical digital platforms: SKHub and DataEx.

In South Asia, the increasing frequency and intensity of extreme weather events- monsoons, tropical cyclones, droughts, and floods—pose significant socio-economic and environmental challenges. Timely and accurate forecasting is crucial for disaster risk reduction, climate resilience, and early warning systems. However, many meteorological agencies face challenges in effectively collecting, analyzing, sharing, and interpreting meteorological and climate data. To address these gaps, SKHub and DataEx were developed as dedicated platforms that facilitate knowledge management and data.

RATIONALE FOR THE TRAINING

The workshop was organized in response to the growing need for enhanced meteorological forecasting, data accessibility, and knowledge-sharing in South Asia. The region is highly vulnerable to extreme weather events such as monsoons, tropical cyclones, floods, and droughts, which have devastating impacts on lives, livelihoods, economies, and infrastructure. As climate change intensifies, these hazards are becoming more frequent and unpredictable, necessitating more accurate forecasting and effective early warning systems.

While NMHSs across South Asia play a critical role in monitoring and predicting weather patterns, they often face technical and operational challenges, including:

- Limited access to real-time and high-resolution meteorological data.
- Gaps in technical expertise in utilizing advanced forecasting, visualization, and data-sharing tools.
- Inconsistent data-sharing practices and lack of regional collaboration.
- Inadequate training opportunities to keep pace with evolving meteorological technologies and methodologies.

To address these challenges, SKHub and DataEx were developed as innovative digital solutions that offer a centralized knowledge repository, interactive learning tools, and advanced data-sharing capabilities. However, for these platforms to be effectively utilized, targeted training was necessary to ensure NMHS personnel and stakeholders could fully integrate these tools into their operational workflows.

TRAINING OBJECTIVES

The workshop aimed to:

1. Provide a comprehensive overview of both platforms, highlighting their functionalities and applications and its integration with RDAS.
2. Demonstrate practical applications of the platforms, including accessing and analysing forecast data.
3. Facilitate discussions on data sharing, capacity building, and strategies for collaborative engagement to enhance regional forecasting capabilities.

PARTICIPANTS

The training included 12 professionals from various NMHSs and sectoral institutions across South Asia. The gender distribution was predominantly male, with 10 male participants and 2 female participants. The attendees represented hydrometeorological institutions from SAHF member countries, including departments from Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. Their roles varied from meteorologists and scientists to heads of forecasting departments, showcasing a range of responsibilities and expertise levels.

SESSION HIGHLIGHTS

SESSION 1: INTRODUCTION TO SKHUB: FEATURES AND SALIENCE

Resource Person: Mr. Surajan Shrestha, Web Developer-SKHub, RIMES
Type of Methodology Used: Presentation and Demonstration

The session provided an in-depth demonstration of the SAHF Knowledge Hub (SKHub), a dedicated platform designed to enhance learning, knowledge sharing, and capacity building in the fields of hydrology, meteorology, and climate services. The presenter introduced participants to the key features of SKHub, emphasizing its role in consolidating educational resources, professional expertise, and data-sharing tools under one platform.

The session highlighted the platform's ability to provide open-access learning resources, structured courses through its Learning Management System (LMS), access to archived reports from the Forecasters' Forum, and integration with the Data Exchange (DataEx) platform. Participants were also introduced to features such as course progress tracking, certification issuance, expert resource directories, and interactive discussion forums. The presentation outlined upcoming features, including interactive quizzes, a Community of Practice (CoP), and additional training courses on specialized tools like DataEx. The presenter underscored the long-term vision of SKHub in ensuring continuity of learning and professional development, particularly in the face of frequent personnel changes within government agencies.

Session Output:

- Participants gained an understanding of the Knowledge Hub's features and objectives, including its role as a centralized repository for hydrometeorological knowledge and resources.
- The session showcased LMS functionalities such as course enrolment, progress tracking, interactive discussions, certification management, and expert-led learning modules..
- Recognition of the SKHub as a long-term capacity-building tool for the South Asian meteorological community.
- Emphasis on the need for regional expert contributions to enrich the platform's content.
- Agreement on the importance of continuous updates and refinements to incorporate user feedback, emerging thematic areas, and additional training resources.

Issues/Concerns Raised and Resolutions:

Issue/Concern	Resolution/Action Point
Collaboration with other meteorological organizations, such as South Asian Meteorological Association (SAMA).	Engagement with SAMA and similar organizations will be explored to integrate relevant training materials and expert resources while ensuring alignment with the Knowledge Hub's objectives.
Absence of a regional glossary with standardized meteorological definitions.	A dedicated glossary section will be developed to provide a comprehensive reference for terms commonly used across National Meteorological and Hydrological Services (NMHSs) in the region.
Need for specialized training on seasonal weather events.	Event-based training modules will be incorporated to address seasonal forecasting challenges and enhance regional forecasting capabilities.
Requirement for a structured evaluation mechanism for certification courses.	A quiz-based assessment system will be integrated, ensuring that participants undergo module-wise evaluations before receiving certification.
Concerns regarding user registration security, particularly email authentication.	It was clarified that the SKHub operates on a secure, standalone login system and does not require personal email credentials. A password recovery mechanism is in place for user account management.
Need for accessible refresher training programs and reference materials.	Plans are in place to upload refresher course materials from regional training centers, including adapted WMO manuals for operational forecasting.
Limited access to research papers and scientific publications.	Due to copyright restrictions, direct uploads are not feasible; however, a curated list of relevant journals and open-access research papers will be linked to the platform.

SESSION 2: INTRODUCTION TO DATAEX PLATFORM
Resource Person: Mr. Nazmul Ahasan, Country IT Lead, RIMES *(Online)*
Type of Methodology Used: Presentation and Demonstration

The second session provided a comprehensive overview and demonstration of the Data Exchange (DataEx) platform, a regional meteorological data-sharing and analysis system designed to enhance forecasting capabilities across South Asia. The presenter explained the evolution of DataEx, initially developed to facilitate high-resolution forecast data exchange between ECMWF, NMHSs, and RIMES, and how it has grown into a full-scale data visualization, analysis, and verification platform.

Key features of DataEx were demonstrated, including forecast visualization tools, observational data integration, forecast verification techniques, automated data processing, and real-time alert systems. Participants were shown how to subset, download, and analyze forecast data, customize visual outputs using shapefiles, and automate data retrieval via command-line tools and APIs. The platform's access control mechanisms were also discussed, ensuring secure data-sharing agreements between countries while allowing individual NMHSs to retain control over their data.

The session also covered forecast verification methodologies, illustrating how DataEx enables users to compare forecast outputs with observed data, perform bias correction, and analyze extreme events. Additionally, future developments were outlined, including expanded forecast domains, integration of ECMWF reanalysis datasets, improved ensemble forecast analysis, and AI-driven bias correction techniques.

Session Outputs:

- Participants gained a comprehensive understanding of DataEx as a regional meteorological data-sharing and analysis platform.
- Participants developed proficiency in utilizing DataEx's forecast visualization and data extraction tools.
- The session reinforced the importance of integrating observational data into forecasting workflows. Participants were introduced to methods for incorporating non-GTS station data into forecast models, highlighting DataEx's role in enabling controlled data-sharing agreements between NMHSs.
- Participants gained practical knowledge of forecast verification techniques within DataEx.
- Users were introduced to automation tools designed to streamline forecasting operations.
- The session highlighted the benefits of real-time alerts and threshold-based notifications.
- Future developments, including AI-driven bias correction and expanded forecast model coverage, were acknowledged as key advancements.

Issues/Concerns Raised and Resolutions:

Issue/Concern	Resolution/Action Point
Restricted access to real-time observational data from certain countries	DataEx operates on a sandboxed permission system, allowing NMHSs to retain data-sharing control while enabling selective regional collaboration.
Need for expanded historical forecast datasets for trend analysis	Users currently have one month of historical forecast data available. Additional archived datasets will be made accessible upon request.
Handling large forecast datasets efficiently	The Forecast Subset Module allows users to download smaller, region-specific datasets, minimizing storage and processing challenges.
Customization of forecast visualizations for country-specific applications	The Forecast Graphics Module enables users to upload custom shapefiles and generate tailored plots.
Lack of automation for forecast graph generation.	The API now supports automatic graph generation, eliminating the need for manual processing.
Why is GRADS still used for some functions instead of Python-based tools?	The long-term goal is a full transition to Python, with all new tools developed in Python-based frameworks.

Limited domain coverage in IMD WRF model outputs.	IMD WRF forecasts currently use default simulation domains. Plans are underway to incorporate IMD GFS forecasts, which cover all SAHF member countries.
Visualization and probability analysis of ECMWF ensemble forecasts.	Future updates will introduce full ensemble visualization and probability-based extreme event detection tools.
Automatic API integration for operational forecasting.	The API allows automated data retrieval, graph generation, and forecast verification, supporting NMHSs in operational forecasting workflows.

SESSION 3: MONSOON 2023 VERIFICATION
Resource Person: Mr. Md. Khan Golam Rabbani, Weather Expert, RIMES
Type of Methodology Used: Presentation

The session focused on verifying ECMWF HRES deterministic forecast products during the 2023 monsoon season across 22 RIMES member countries. Mr. Md. Khan Golam Rabbani, presented the evaluation results, analyzing forecast accuracy for the first five days (120 hours) of lead time. The verification process used binary verification, extreme event analysis (CRA method), and skill score assessments such as Probability of Detection (POD), False Alarm Ratio (FAR), Hanssen Kuipers' Discriminant (HK), and Threat Score (TS). Findings indicated that forecast accuracy was highest in India, the Philippines, and parts of Southeast Asia, while Afghanistan, Nepal, and Sri Lanka showed weaker forecast performance, particularly for extreme rainfall events. Forecast errors related to displacement, intensity, and pattern misrepresentation were observed in cases such as Cyclone Biparjoy (India, June 2023), extreme flooding in Bangladesh (June 2023), and heavy rainfall events in Myanmar, Sri Lanka, and Nepal.

The session highlighted the need for a more detailed country-specific verification process to identify which forecast models perform best at national and subnational levels. Participants discussed utilizing multiple reanalysis datasets (EMER, ERA5, IMDAA, etc.) to determine which datasets are most representative of specific regions, particularly during extreme events. A key takeaway was the importance of point-scale verification for high-risk areas with high population density, where even small errors in forecasting can lead to significant disasters.

Additionally, past initiatives, such as training workshops with NCMRWF involving representatives from SAARC countries, were mentioned as foundational steps towards advancing national and subnational-scale verification. The session also introduced upcoming methodologies, including H3ALA, a process already in use in some Indian states, aimed at improving impact-based forecasting (IBF) by ensuring more accurate and reliable predictions for user sectors.

Session Outputs:

- Improved understanding of forecast accuracy across different RIMES member countries, highlighting regional variations.
- Emphasis on country-specific verification to enhance localized forecasting capabilities.
- Recognition of limitations in forecasting extreme events, including displacement and intensity errors.

- Discussion on the role of multiple reanalysis datasets (EMER, ERA5, IMDAA, etc.) in refining forecast evaluations.
- Need for further support from NMHS partners to conduct in-depth verification at national and subnational levels.

Issues/Concerns Raised and Resolutions:

Issue/Concern	Resolution/Action Point
Forecast errors in complex terrain regions (e.g., Afghanistan, Nepal, Bhutan)	Further model calibration and localized data assimilation are needed to improve accuracy in high-altitude and complex topographical regions.
Increasing forecast uncertainty at longer lead times (Day 4-5)	Incorporating probabilistic forecasts and ensemble model outputs can help better capture uncertainty beyond Day 3.
Challenges in forecasting extreme rainfall events and cyclones	Future analyses should include intensity correction techniques, high-resolution regional models, and improved cyclone track forecasting methodologies.
Need for country-specific verification and impact-based forecasting	A more detailed breakdown of forecast performance per country will be conducted to refine sector-specific applications and local early warning systems.
Differences in forecast accuracy between regions (e.g., strong in India, weak in Afghanistan & Sri Lanka)	Efforts will be made to enhance data availability, assimilate more observational data, and integrate machine learning techniques for bias correction.
Integration of ECMWF ensemble forecasts for longer lead times	Plans are in place to evaluate ECMWF ensemble forecasts (Day 6-10, 15-day products) to enhance probabilistic forecasting over RIMES member countries.

Session 4: High-Resolution Rapid Refresh Model (HRRR)
Resource Person: Dr. Ananda Kumar Das, Scientist F, India Meteorological Department (IMD)
Type of Methodology Used: Presentation

Session Summary:

This presentation focused on advancements in regional weather modeling, specifically the HRRR system and its applications for short-term forecasting. The HRRR model provides hourly updates by assimilating real-time radar and AWS data, significantly improving the accuracy of high-impact weather predictions. Key topics covered included lightning prediction using Electric WRF, urban-scale modeling, coupled regional models, and monthly verification of forecast accuracy. Additionally, updates on the Indian Ocean Coupled Model and its role in enhancing regional forecasts were discussed.

The discussion highlighted how data assimilation techniques are evolving to improve forecasting accuracy, particularly for extreme weather events. The HRRR system, combined

with new verification tools, aims to empower national meteorological agencies with better forecasting capabilities. The session also emphasized the importance of sharing verification tools so that countries can evaluate and improve their own forecasting systems.

Session Output:

- Enhanced understanding of the HRRR model and its role in high-resolution, short-term weather forecasting.
- Exposure to advanced data assimilation techniques, including real-time radar and lightning data integration.
- Access to new verification tools for evaluating forecast accuracy at the national level.
- Awareness of monthly verification statistics available on the IMD website.
- Potential for API access to model outputs for seamless integration into national systems.
- Improved knowledge of extreme weather prediction and early warning systems.
- Encouragement for regional collaboration in data sharing and model development.

Issues/Concerns Raised and Resolutions:

Issue/Concern	Resolution
Availability of lightning forecast data for operational use	IMD will integrate lightning forecasts into Data X, making them more accessible to users.
API access for forecast data	API development is in progress; IMD plans to make data available for external integration.
Verification of national models using IMD's verification tools	Countries can access password-protected verification data on the IMD website. Requests for access will be facilitated.
Data assimilation of multiple lightning networks	IMD currently uses a nudging approach, but work is underway for a fully integrated assimilation method.
Nepal's request for immediate access to lightning data	IMD will work on expediting data sharing for integration into Nepal's Disaster Risk Management System.

Session 5: DataEx Platform Training and Geospatial Data Analysis

Session Summary

Session 5 focused on training participants in the use of the DataEx platform for geospatial data processing, extraction, and analysis. The session provided an in-depth demonstration of key platform functionalities, including shapefile uploads, time-series data extraction, spatial reducers for calculating regional statistics, and format conversion (CSV, XLSX). Participants were guided through workflows for computing daily weighted averages over specific regions and visualizing extracted data for further analysis.

Throughout the session, participants engaged in hands-on exercises, reinforcing their understanding of DataEx platform's capabilities and its applications in climate data analysis and decision-making. A key discussion point was the need for additional country-specific training to ensure users can fully leverage the platform. Furthermore, concerns were raised regarding Python proficiency among participants, which was identified as a prerequisite for

utilizing advanced functionalities. As a resolution, an introductory Python training was proposed to bridge this gap.

The session concluded with an open discussion where participants provided valuable feedback on data extraction challenges, visualization improvements, and platform usability. The training team acknowledged these concerns and outlined potential enhancements, including expanded documentation, customization options for visual outputs, and improved data formatting features.

Session Output

- Participants successfully uploaded and processed shapefiles within the DataEx platform.
- Learned to apply spatial reducers for computing regional rainfall averages and other statistical calculations.
- Gained hands-on experience in extracting, downloading, and analyzing time-series data in multiple formats.
- Understood the workflow for integrating DataEx outputs into operational climate data analysis.
- Identified key areas for platform improvement, including enhanced visualization features, additional data formatting options, and the need for more structured training programs.

Issues/Concerns Raised and Resolutions

Issue/Concern	Resolution/Action Point
Need for more training sessions to cover all platform features	Country-specific training sessions will be organized, starting with BMD and DHM, with additional sessions based on demand.
Limited Python proficiency among participants	A structured introductory Python course will be introduced to support participants in effectively utilizing the platform.
Challenges in extracting and formatting data efficiently	Enhancements will be made to data formatting options and downloadable file structures to streamline data handling.
Lack of direct visualization support for GeoJSON files	A GeoJSON file viewer feature will be explored for future integration into the platform.
Customization options for visualization outputs	Future updates will introduce options for custom color schemes, unit labeling, and enhanced graphical representations.
Need for improved documentation and user guides	The training team will expand tutorials and technical documentation to provide comprehensive user support.

Training Outcomes

1. Participants gained in-depth knowledge of SKHub and DataEx, including their features, functionalities, and applications in hydrometeorology, climate services, and

data analysis. Hands-on exercises improved their ability to visualize, extract, and analyze meteorological data effectively.

2. Training on forecast verification, ensemble forecasting, and high-resolution modeling equipped participants with techniques to assess and improve forecast accuracy, particularly for extreme weather events.
3. Discussions highlighted the importance of regional collaboration, data-sharing agreements, and expert contributions to enhance SKHub and DataEx.
4. Identified gaps in Python proficiency and data-handling skills led to the proposal of structured training programs, including introductory Python courses and country-specific DataEx workshops.
5. Feedback-driven improvements were outlined, including API development, enhanced visualization tools, additional training materials, and structured evaluation mechanisms for certification courses.

KNOWLEDGE, SKILLS, AND ABILITIES (KSA) FINDINGS

FEEDBACK RESULTS

Out of the __ participants, there were nine (9) respondents to the feedback survey–all male, two-thirds belonging to the 41-60 age range while the remaining third is aged 21-40.

A comparison of respondents' knowledge levels before and after the training indicates an increase in expertise. There was a **20.55%** improvement in integrating climate change considerations into professional work, a **37.50%** increase in knowledge of SKHub core modules and the Learning Management System (LMS), and a **38.89%** rise in familiarity with DataEx.

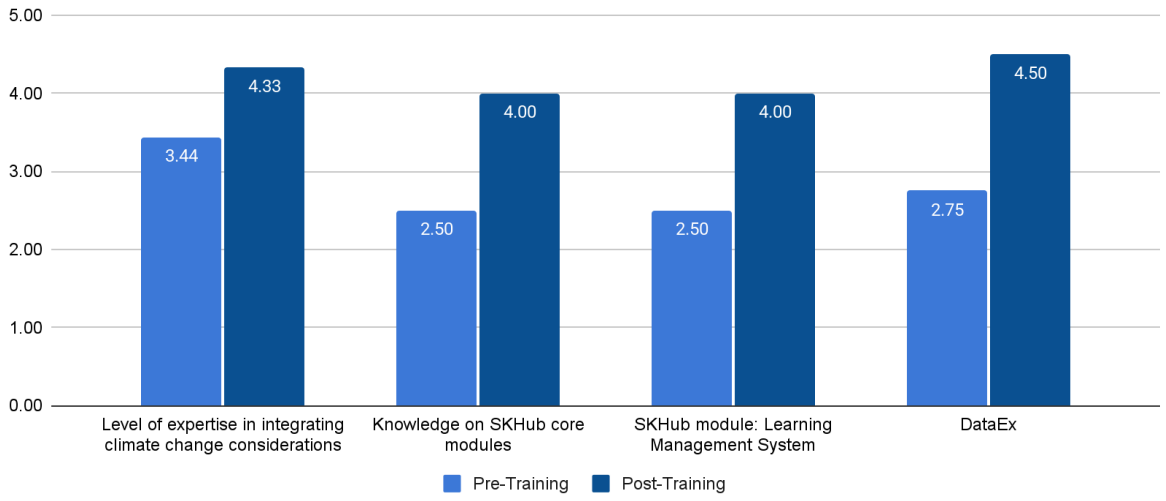


Figure 1. Knowledge gained by the participants pre- and post-training

Most aspects of the training received ratings between "Good" and "Very Good". However, 22.22% of respondents rated the relevance and usefulness of materials as "Moderate," possibly due to the technical complexity of the DataEx platform. Time allocation also received lower ratings, with 33.33% marking it as "Moderate" and 11.11% as "Very Poor," suggesting insufficient time for hands-on training.

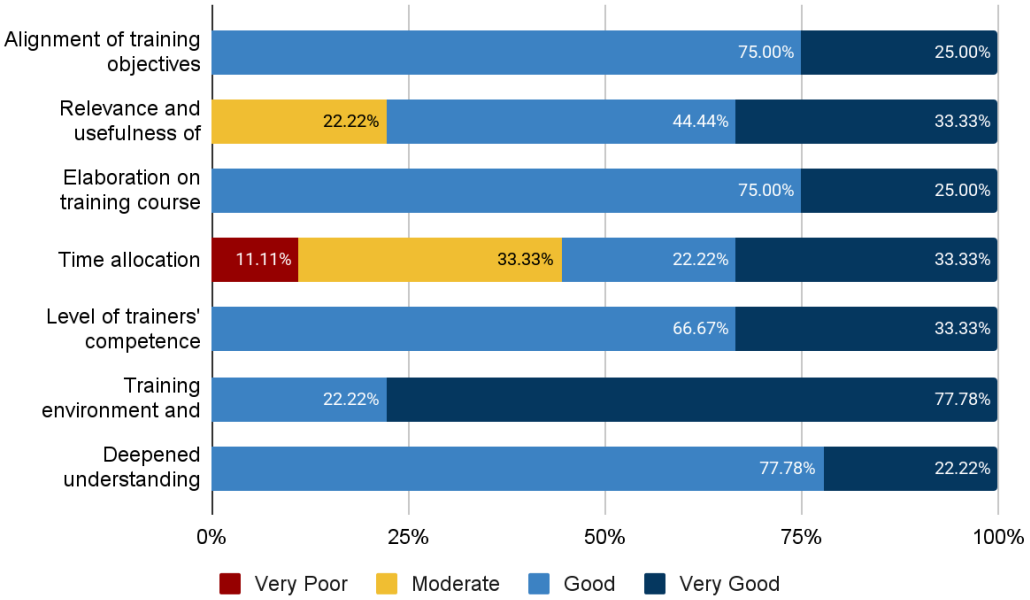


Figure 2. Satisfaction rating on the different aspects of the training

In terms of training objectives, two-thirds of respondents rated their clarity as "Good," while the remaining respondents either missed or did not answer the question. Achievement of objectives received "Good" to "Very Good" ratings overall. The training aimed to balance theoretical presentations with practical exercises, and 88.89% of respondents rated this aspect positively, though 11.11% gave it a "Moderate" rating.

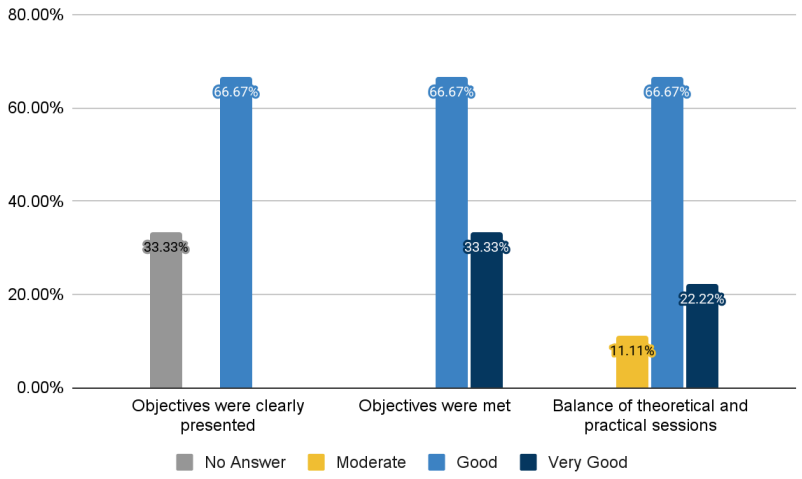


Figure 3. Achievement of objectives and balance of training methodologies

To summarize the key evaluation areas of the training:

The training was well-received across key evaluation areas:

- **Relevance:** The majority (**88.89%**) agreed that the training was designed based on the needs of target beneficiaries and followed an inclusive and participatory

approach. Participants recognized its alignment with their work and found it applicable to local contexts.

- **Coherence:** The training complemented existing government priorities, policies, and frameworks, with most respondents rating it as **"Good" to "Very Good."** It effectively addressed gaps in climate information application and promoted synergy among programs, projects, and activities related to climate risk management.

- **Effectiveness:** The training significantly strengthened participants' knowledge of proactive and anticipatory climate risk management, with **100%** rating it as **"Effective" or "Very Effective."** It also enhanced the adoption of best practices and improved understanding of climate information usage for preparedness planning and decision-making.

- **Impact:** Participants acknowledged the training's influence on policy-making, planning, and decision-making within their departments. The majority (**66.67% Agree, 33.33% Strongly Agree**) expressed intent to incorporate the learnings into future projects, with a similar proportion likely to apply training outcomes in their work. The training also shifted perspectives on work approaches.

- **Sustainability:** Respondents committed to sharing knowledge with colleagues, fostering a culture of continuous learning, and improving collaboration across agencies. Many recommended integrating the training into internal documents and making it a regular capacity-building initiative to reach a wider audience.

Overall, the training was deemed relevant, effective, and impactful, with strong potential for long-term sustainability and integration into institutional practices.

Individual results for the key evaluation areas are discussed in the following section:

Relevance

Regarding relevance, 88.89% of respondents agreed that the training was designed based on the needs of target beneficiaries, while 11.11% were undecided. All respondents agreed that the training followed an inclusive and participatory approach to ensure relevance to local needs.

One participant commented that *"Overall, the training arrangement and content covered within the limited time period was very good."*

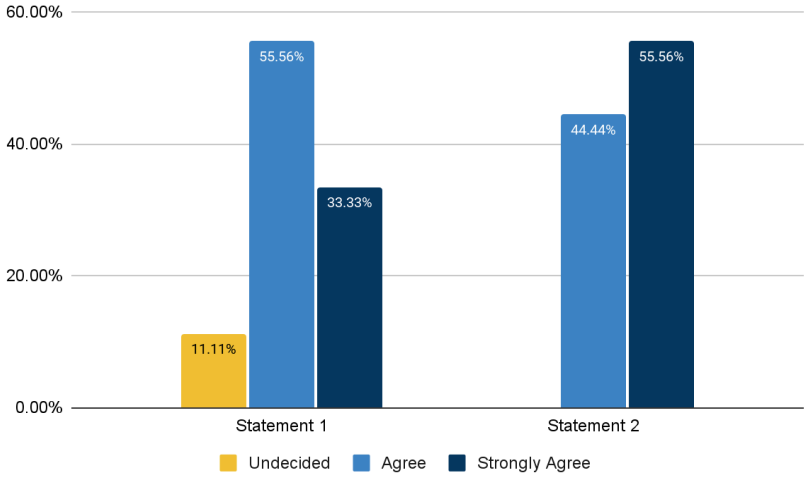


Figure 4. Respondents' satisfaction on relevance of the training.

Coherence

In terms of coherence, the training aligned well with existing government priorities, policy frameworks, and guidelines (Statement 1), with 11.11% rating it as "Moderate," 55.56% as "Good," and 33.33% as "Very Good." It effectively addressed emerging issues in proactive sectoral climate change adaptation and climate risk management (Statement 2), with 11.11% of respondents giving a "Moderate" rating, 66.67% rating it as "Good," and 22.22% as "Very Good." The training also contributed to bridging gaps in climate information application in operational, tactical, and strategic decision-making (Statement 3), receiving 55.56% "Good" and 44.44% "Very Good" ratings.

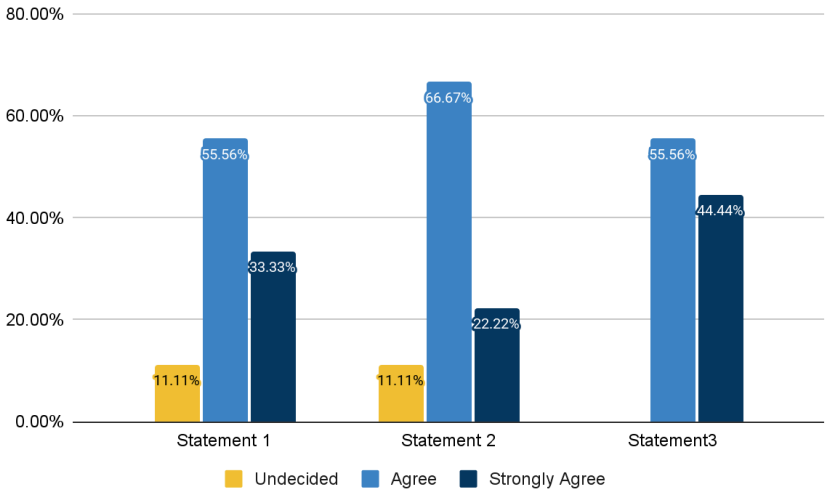


Figure 5. Respondents' satisfaction on coherence of the training.

Participants acknowledged the training's contribution to improving climate information application in planning and decision-making. **55.60%** agreed that it helped ensure synergy and complementarity of activities to maximize preparedness (Statement 1), while **100%** recognized its role in enhancing access to climate information and promoting institutional collaboration (Statement 2). Additionally, **55.60%** agreed that

the training improved disaster risk reduction skills by learning from best practices (Statement 3), and **66.70%** saw benefits in strengthening anticipatory preparedness measures for potential weather and climate events (Statement 4). One respondent also suggested further linking climate data with hydrology.

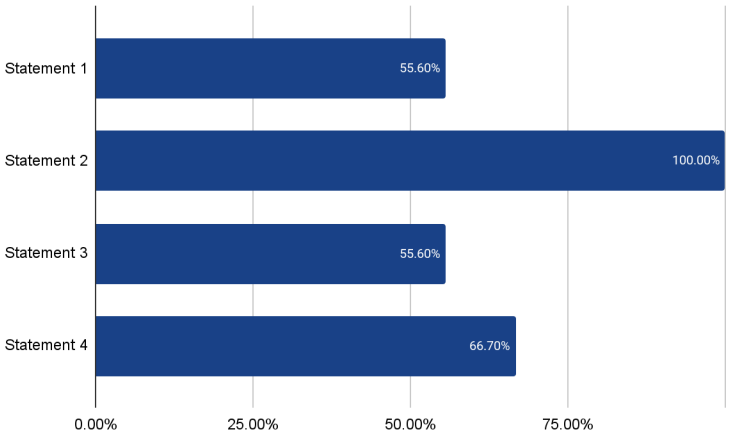


Figure 6. Respondents' agreements as to how the training is complementing/contributing to other programs, projects, and activities vis-a-vis climate information application in plans and decisions

Effectiveness

The training effectively strengthened participants' knowledge of proactive and anticipatory climate risk management (Statement 1), with 66.67% rating it as "Effective" and 33.33% as "Very Effective." Similarly, its activities successfully promoted the adoption of best practices and innovative approaches in climate risk management, receiving the same ratings (Statement 2).

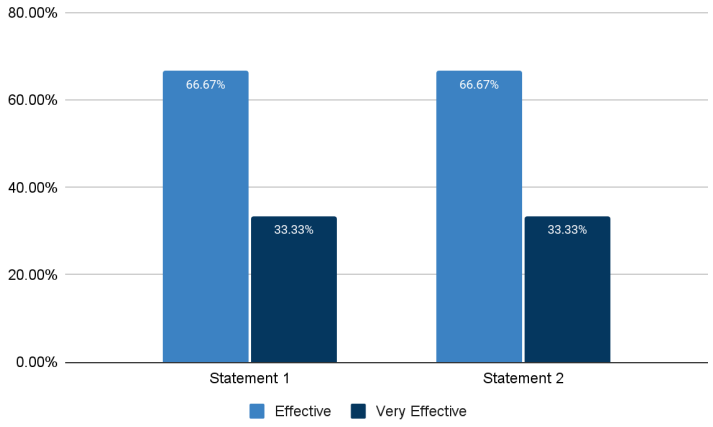


Figure 7. Respondents' satisfaction on the effectiveness of the training.

In terms of how the training has been effective in addressing gaps in climate information application in planning and decision-making, 77.80% of respondents agreed that it enhanced NMHSs climate information products based on stakeholder feedback (Statement 1). Additionally, 88.90% agreed that it improved stakeholders' understanding of the seamless use of climate information for short-, medium-, and long-term preparedness (Statement 2). A

further 88.90% acknowledged that it strengthened climate risk-informed, anticipatory preparedness planning and decision-making among sectoral stakeholders (Statement 3).

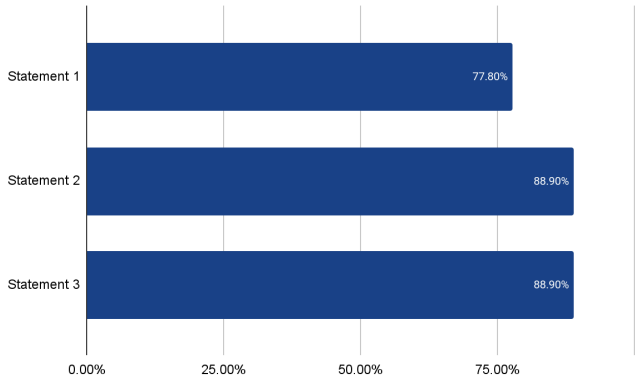


Figure 8. Respondents' agreements as to how the training has been effective in addressing gaps in climate information application in plans and decisions

Impact

The training is expected to have a positive influence on policy-making, planning, financing, and decision-making regarding climate change adaptation and climate risk management (Statement 1). 55.56% of respondents agreed with this statement, while 33.33% strongly agreed and 11.11% gave a "Moderate" rating. Additionally, 66.67% agreed and 33.33% strongly agreed that they are likely to incorporate the knowledge and skills gained into current or future projects related to climate-informed designs, standards, policies, and planning (Statement 2). When asked about applying training outcomes in their work (Statement 3), 55.56% agreed and 44.44% strongly agreed. Furthermore, the training influenced participants' perspectives on how they would approach their work differently (Statement 4), with 55.56% agreeing, 33.33% strongly agreeing, and 11.11% giving a "Moderate" rating.

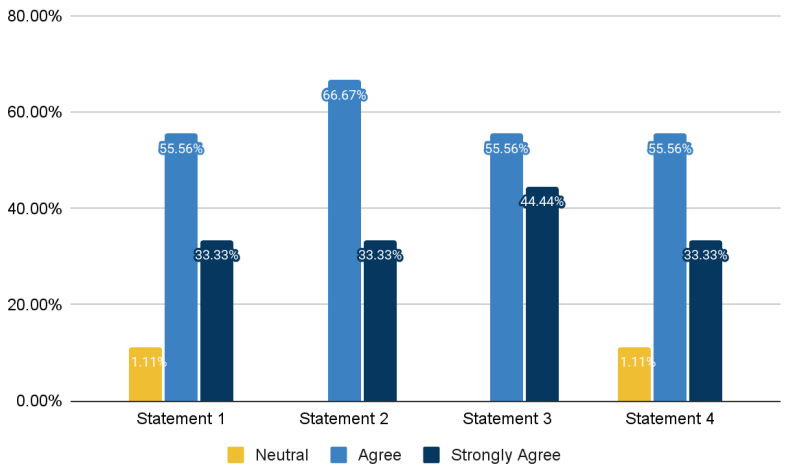


Figure 9. Respondents' satisfaction on the impact of the training.

Sustainability

Overall, respondents expressed strong agreement with the sustainability aspects of the training:

Statement 1: They will share the course material and learnings among their colleagues.

Statement 2: The training they received has inspired them to explore new ideas and approaches.

Statement 3: The training is fostering a culture of continuous learning and improvement within their department regarding climate change.

Statement 4: The training is likely to improve their collaboration with other colleagues/units in their agency/other agencies involved in the project.

Statement 5: They recommend integrating the learnings of the training into their internal documents.

Statement 6: They recommend making this training a regular part of their organization's capacity building initiatives to reach a wider audience.

Statement 7: They recommend this training to other related governmental organizations.

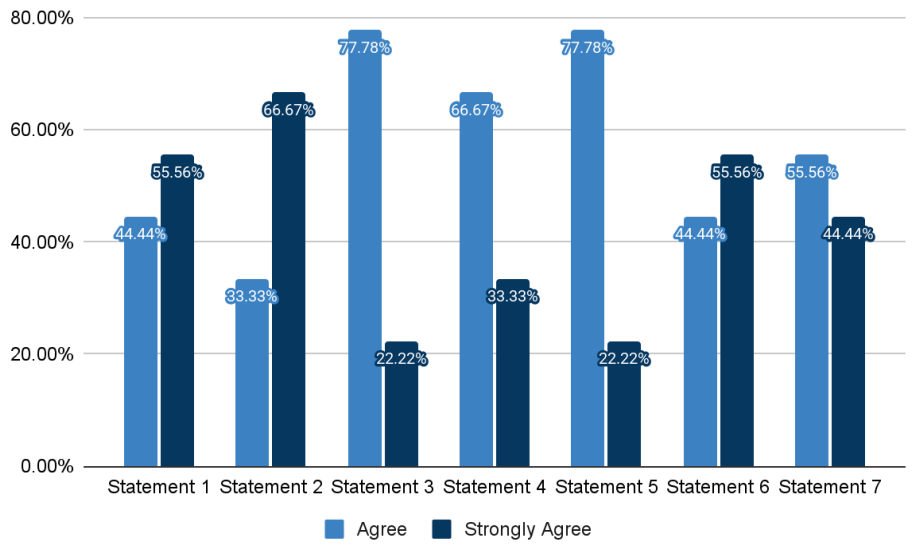


Figure 10. Respondents' satisfaction on sustainability of the training.

Commendations

The feedback on the event highlights several positive aspects, including the well-organized logistics, quality of the training sessions, and the effectiveness of platforms like SKHub and DataEx. Participants appreciated the diversity of topics covered, the interactive nature of the training, and the overall thoroughness of the program. While DataEx was seen as a promising tool, some noted the need for additional data sources and simplification of manual code editing. The training was seen as comprehensive, with some suggesting that more time could be allocated to specific areas, such as Python basics.

Key Takeaways

Participants gained valuable insights into data analysis, software platforms, and data exchange. Many highlighted the importance of DataEx for forecasting and information dissemination. The training also provided knowledge on using various climate data types, integrating weather and climate information, and enhancing forecasting capabilities. Learning Python and Linux was another notable takeaway for some participants.

Recommendations

Recommendations for future training sessions include increasing hands-on practical sessions, providing more detailed training at the organizational level, and ensuring datasets cover all member countries' geographical areas. Other suggestions include arranging refresher courses, adding programming and theoretical lectures, and selecting participants based on experience. Regular training programs were also emphasized to ensure sustainability, technology transfer, and long-term capacity building.

DISCLAIMER: The feedback form was distributed to the participants in print. Although this makes the survey more accessible to the participants, they are also prone to miss answering items especially if presented accordingly. This caused some items of the questionnaire to receive less answers than the total number of respondents.

NEXT STEPS

To effectively implement the recommendations from the workshop, the following steps will be taken to enhance training, improve platform usability, and expand outreach:

SKHub

- Enhance LMS training content and interactivity by integrating quiz features at the end of each module to reinforce learning. These quizzes could be designed to test understanding, recall, and practical application of key concepts.
- Develop a glossary of SAR-specific terminologies to ensure clarity and consistency in technical concepts. This glossary will include definitions of commonly used SAR-related terms, including remote sensing terminology, technical jargon, and any abbreviations.
- Create a dedicated manual on climate change and teleconnections with expert input to provide a comprehensive resource for participants. Collaborate with climate scientists and experts to create a robust manual that covers the science of climate change and the impact of teleconnections on weather patterns.
- Introduce a feedback mechanism to collect both general and training-specific input, helping refine future sessions based on participant needs.
- Integrate season-wise courses and refresher materials with expert contributions to ensure updated and context-specific learning opportunities. Develop specialized training courses that align with specific seasons, such as wet and dry seasons, and address the unique challenges and phenomena relevant to each period. Expert contributors could share insights on seasonal forecasting and how SAR data can be applied for more accurate predictions. These materials should be easily accessible for participants to revisit as needed.
- Expand knowledge sharing and collaboration by introducing a CoP feature to facilitate peer learning and ongoing discussions: The feature would provide a

platform for participants to collaborate, share knowledge, and ask questions. This can include discussion boards, forums, or virtual meetings where participants can exchange experiences, ideas, and challenges.

- Integrate best practices from the region by including forecasters' manuals and scientific publications as reference materials. Curate a collection of relevant forecasters' manuals, research papers, and scientific publications from the region that can provide insights into local forecasting practices.
- Collate and incorporate training resources from other platforms like SAMA into SKHub to enhance learning accessibility. This would ensure that users have access to a broader set of tools and materials, improving the comprehensiveness of the training experience.

DataEx

- Strengthen technical training and practical application by providing more hands-on learning opportunities through practical exercises. Design training sessions that incorporate real-life case studies and practical exercises, allowing participants to apply what they have learned in a simulated or real-world context. This could include working with SAR data, running simulations, and analyzing actual forecasting scenarios. The hands-on approach will help participants understand how to implement their knowledge in day-to-day work.
- Introduce programming sessions focused on introductory Python to equip participants with essential coding skills for data analysis. Offer beginner-friendly programming courses that introduce Python in the context of SAR data analysis. These sessions can cover data manipulation, visualization techniques, and basic machine learning algorithms, all tailored to the needs of SAR professionals. Providing downloadable coding examples and exercises would further enhance the learning experience.
- Organize country-specific training sessions tailored to regional needs to ensure relevant and effective learning. Create customized training modules for different countries, focusing on the specific challenges and needs of each region. These could include topics such as local climate patterns, common forecasting challenges, and regional weather phenomena. These country-specific sessions should be created in collaboration with local experts to ensure relevance.
- Improve access to data and platform functionalities by ensuring datasets are accessible across all SAR countries: Ensure that all SAR-related datasets are available and accessible to users in different countries, including those with limited access to high-performance computing resources. This may involve simplifying access processes, offering alternative data formats, or setting up regional data hubs. Additionally, ensuring multi-language support could increase accessibility for non-English speaking users.
- Integrate additional data sources beyond ECMWF to provide a more comprehensive dataset. Expand the range of data sources available to participants by including datasets from other weather models, satellite observations, and global forecasting systems. Incorporating data from diverse sources ensures a more holistic view and allows for better decision-making.
- Enhance API integration to make data interaction more user-friendly: Improve the design of the platform's API to simplify data retrieval and interaction. A more user-friendly API can reduce technical barriers, enabling participants with basic coding skills to access and analyze data more easily. Consider offering detailed documentation and sample code to facilitate smooth integration with existing workflows.

- Add customizable color maps and unit conversion functionalities to improve data visualization and interpretation. Implement features that allow users to customize color maps to fit their specific needs or preferences.
- Enable geojson file viewing within the platform to support spatial data analysis: Implement a feature that allows users to upload and view geojson files directly within the platform.
- Incorporate anomaly plots using satellite observation data (ERA5) and IMDAA data to enhance data-driven insights. Add tools that allow participants to create anomaly plots using satellite data like ERA5 or IMDAA data.
- Implement probability analysis for extreme events using ensemble forecast datasets to improve predictive capabilities. Use ensemble forecast datasets to conduct probability analyses of extreme events such as storms, floods, or droughts. Th
- Develop and provide prewritten scripts to help participants download data and generate graphics with minimal manual coding, streamlining workflows. Provide participants with prewritten Python scripts or other code templates that automate common tasks such as downloading datasets, processing them, and generating visualizations.

ANNEX 1: TRAINING AGENDA

Time	Activity	Facilitator/Speaker/ Presenter
9:00 - 9:30 AM	**Registration**	
09:30 AM – 09:40 AM	Acknowledgement of Participants	
9:40 - 10:30 AM	Overview of the SAHF Knowledge Hub (SKHub)	Mr. Surajan Shrestha, Web Developer-SKHub, RIMES
10:30 - 11:00 AM	**Tea Break**	
11:00 - 12:00 AM	Introduction to the DataEx Platform	Mr. Nazmul Ahasan, Country IT Lead, RIMES
12:00 AM – 1:00 PM	Monsoon 2023 Verification	Mr. Khan Md. Golam Rabbani, Weather Expert, RIMES
1:00 - 2:00 PM	**Lunch Break**	
02:00-02:30 PM	High-Resolution Rapid Refresh Model (HRRR)	Dr. Anandakumar Das, Scientist E/ DGM, NWP
02:30 - 3:30 PM	DataEx Platform Training and Geospatial Data Analysis	Mr. Nazmul Ahasan
3:30-3:45 PM	**Tea Break**	
3:45 – 4:45PM	DataEx Platform Training and Geospatial Data Analysis	Mr. Nazmul Ahasan
4:45 - 5:00 PM	Closing Remarks	RIMES

ANNEX 2: PARTICIPANTS LIST

NMHS Participants

No.	Name	Country	Designation	Ministry/Agency
1	**Mr. Md. Bazlur Rashid**	Bangladesh	Meteorologist	Bangladesh Meteorological Department (BMD)
2	**Mr. Kh. Hafizur Rahman**	Bangladesh	Meteorologist	BMD
3	**Dr. Ananda Kumar Das**	India	Scientist E/ DGM, NWP	India Meteorological Department (IMD)
4	**Mr. Ahmed Rasheed**	Maldives	Director Meteorology	Maldives Meteorological Services (MMS)
5	**Mr. Nasooh Ismail**	Maldives	Meteorologist	MMS
6	**Mr. Sujan Subedi**	Nepal	Senior Divisional Meteorologist	Department of Hydrology and Meteorology (DHM)
7	**Mr. Arambawattage Channa Muthukumara Rodrigo**	Sri Lanka	Senior Meteorologist	Department of Meteorology (DoM), Sri Lanka
8	**Mr. Mollah Mizanur Rahman**	Bangladesh	Additional Director General (Admin), Bangladesh Water Development Board,	Bangladesh Water Development Board (BWDB)
9	**Dr. Md.Sazzad Hossain**	Bangladesh	Superintending Engineer	BWDB
10	**Mr. Sarder Udoy Raihan**	Bangladesh	Executive Engineer	BWDB
Virtual Participants				
11	**Dr. Tin Mar Htay**	Myanmar	Assistant Director	Department of Meteorology and Hydrology (DMH)
12	**Ms. Chaw Su Laing**	Myanmar	Staff Officer	DMH

RIMES

No.	Name	Designation
1	**Dr. Anshul Agarwal**	Lead-SAHF
2	**Ms. Ruby Rose Policarpio**	Project Director-CARE Component 1
2	**Dr. K. J. Ramesh**	Advisor (Weather and Climate Services)

3	**Ms. Kousalya V Kumar**	Training Coordinator
4	**Mr. Surajan Shrestha**	Web Developer-SAHF
5	**Mr. Niral Shakya**	Application Development Specialist
6	**Ms. J Elaine J. Layug**	M&E Specialist
7	**Mr. Thanut Rittichai**	Project Coordinator, CARE Component 1
8	**Mr. Raihanul Haque Khan**	Country Program Lead- Bangladesh
9	**Ms. Puja Shakya**	Country Program Lead- Nepal
10	**Ms. Amber Masud**	Country Program Lead- Pakistan
8	**Ms. Sudarat Rakpaung**	Procurement and Administration Manager
9	**Ms. Warisa Krajabnak**	Administrative Associate
10	**Ms. Virinya Piromrungkit**	Administrative Assistant
11	**Mr. Pat Thananchaisirikul**	Administrative Assistant
12	**Ms. Tanchaporn Srisuriya**	Administrative Assistant
Virtual Participants		
6	**Mr. Nazmul Ahasan**	Country IT lead
7	**Mr. Khan Md. Golam Rabbani**	Weather Expert
8	**Dr. Shiromani Jeyawardena**	Advisor (Weather and Climate Services)
9	**Ms. Raissa Jean A. Ancheta**	Communication Specialist

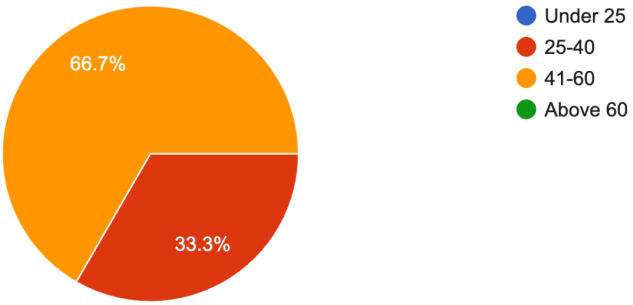
ANNEX 3: FEEDBACK SURVEY

DEMOGRAPHICS

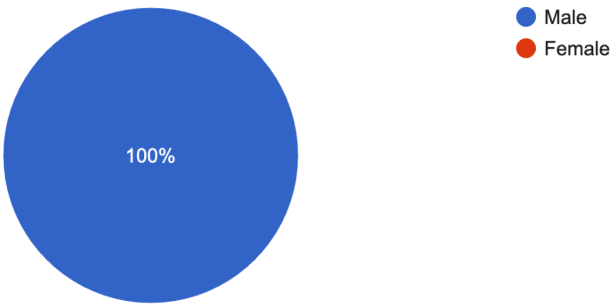
Institutions:

Bangladesh Water Development Board
BMD
Department of Hydrology and Meteorology
Department of Meteorology, Sri Lanka
Flood Forecasting and Warning Centre, Bangladesh Water Development Board
India Meteorological Department
Maldives Met Service
Maldives Meteorological Service

Age group:
9 responses



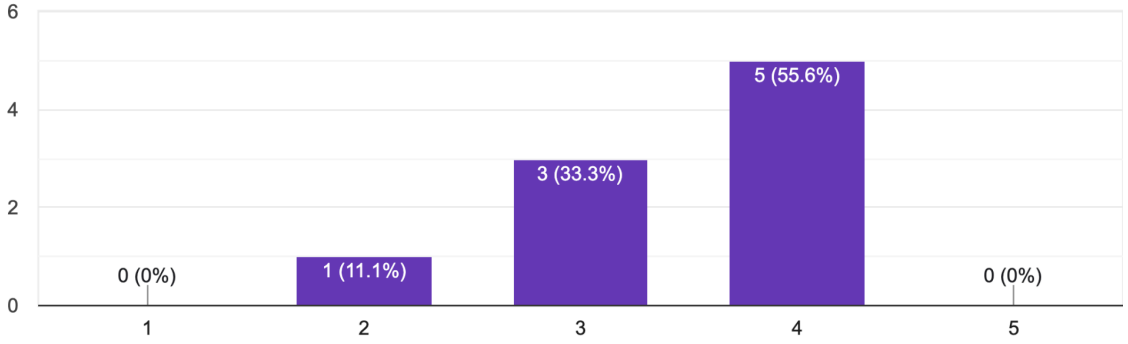
Gender:
9 responses



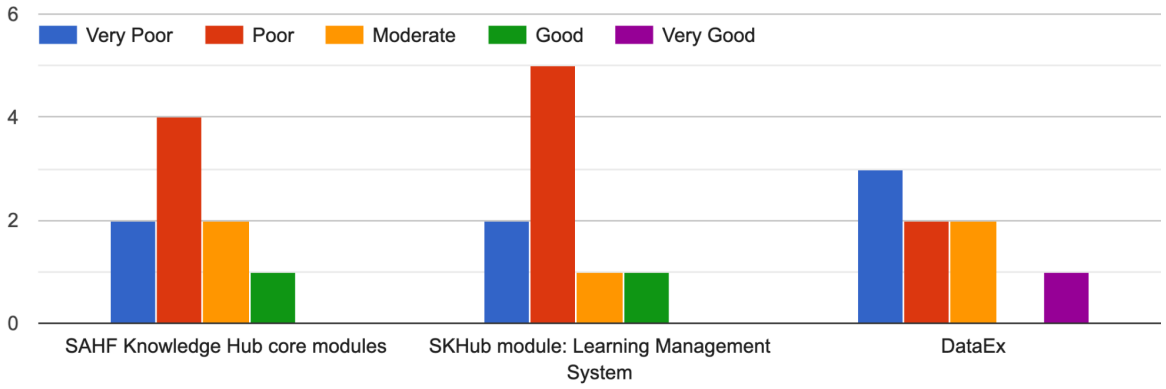
PRE-TRAINING ASSESSMENT

1. Rate your level of expertise in integrating climate change considerations into your professional work.

9 responses

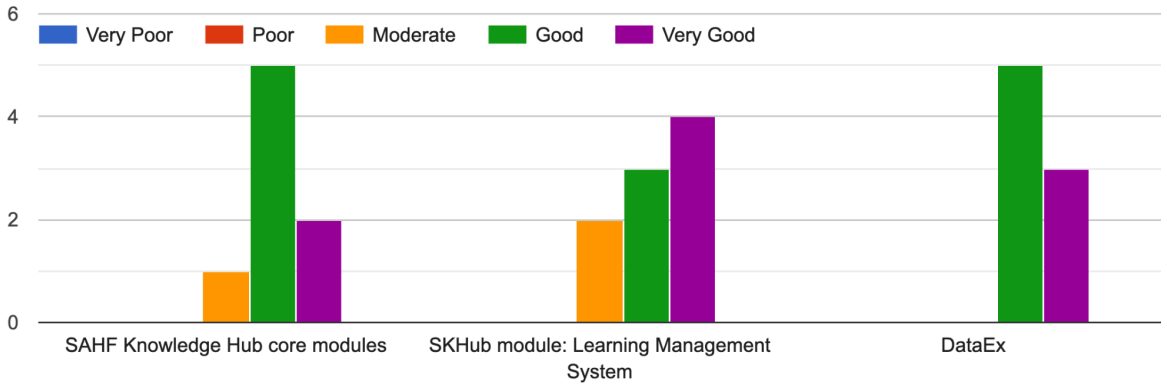


2. Rate your level of knowledge/expertise for the following topics before the training:



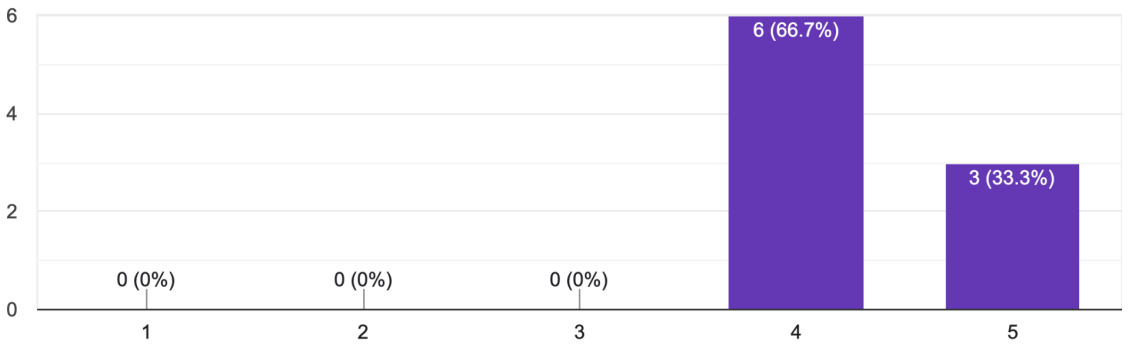
POST-TRAINING ASSESSMENT

3. Rate your level of knowledge/expertise for the following topics after the training:

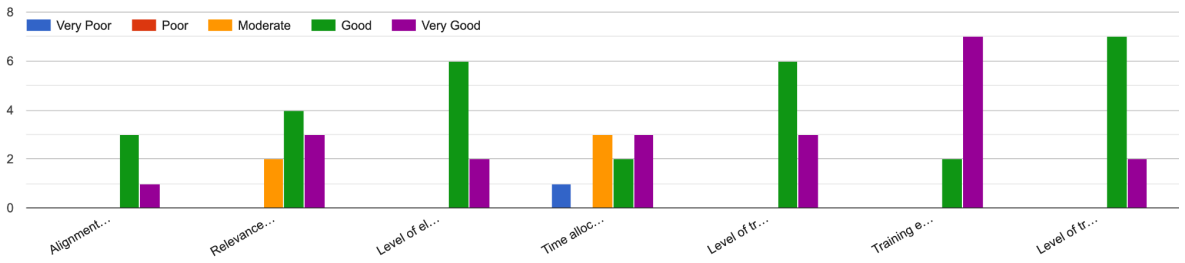


4. Rate your likelihood of integrating climate change considerations into your professional work after the training.

9 responses

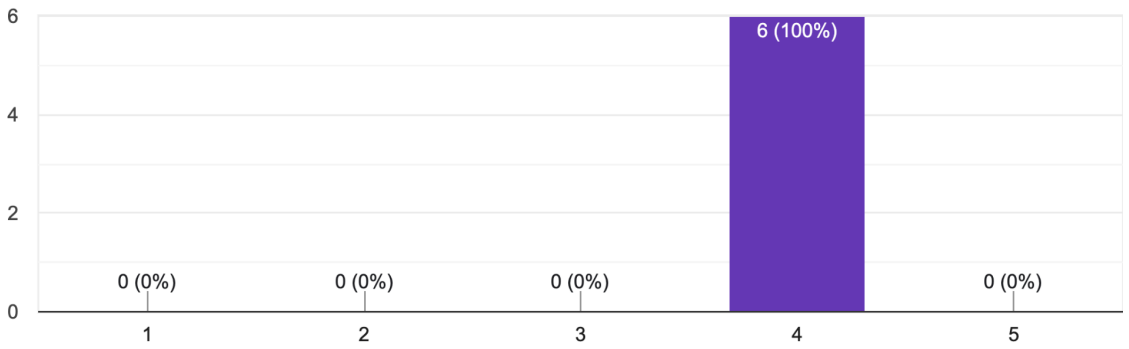


5. Grade the specific parts of the training with regard to your satisfaction level:



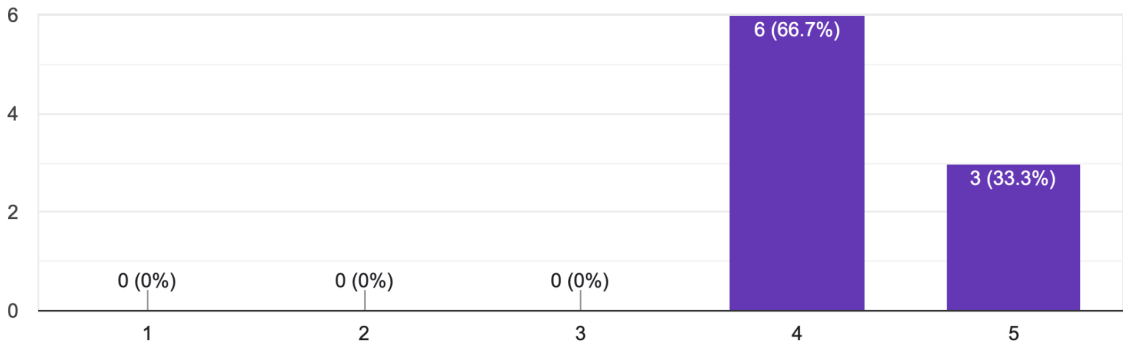
6. The objectives of this training are clearly presented at the start of the training.

6 responses



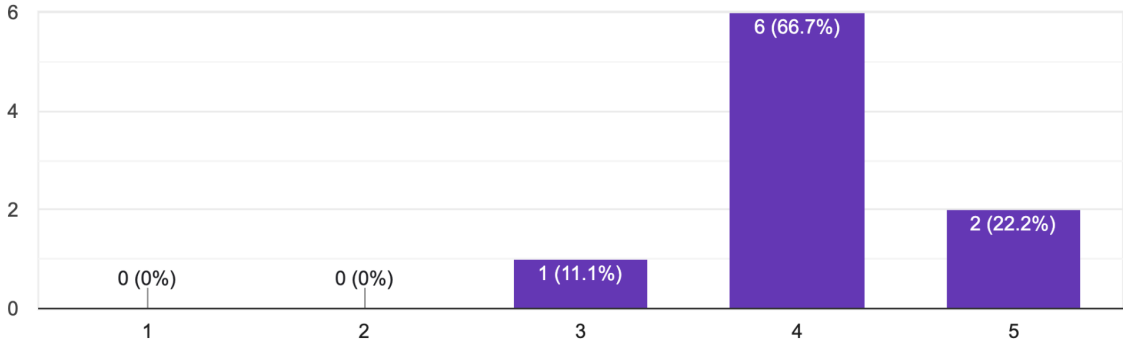
7. The objectives of the trainings were achieved.

9 responses



8. The balance of theoretical/conceptual and practice-oriented sessions was upheld in the training.

9 responses



How can this training help you in your work? Did you have any expectations that were not met?

Encourage the forecasters to maximize the utilization of the platforms

get point forecasts, for basic venhabrions (?)

Nazmul should have been in-person for dataex

In operational flood forecasting

Time could be expanded

It will reduce time that need to spend for data processing.

Among your expectations, which ones were not met? Handon experience need to improve

Knowledge upgradation about the NWP and weather forecasting activities in the South Asian Region. Utility tools DataEx will be very much useful in future work. Exchange of information laid new ways for future collaborations in the field of weather and climate services.

Among your expectations from this training, which ones were not met?
Non specific. But many of them has been covered during feedback session and included in the recommendation.

This training can help in NMHS many ways. First one, it will develop meteorology and hydrology knowledge in the NMHS persons and secondly, it helps data sharing with neighboring NMHS countries.

Which expectations were not met?
This training programmed almost covers many issues but sill no tackles real time data at nigh times

This training would be very useful in any operation work. SKHub will increase my knowledge in forecasting and DataEx will help in my daily forecast.

Among your expectations, which ones were not met?
Not fully, but my expectations from the training met quite good.

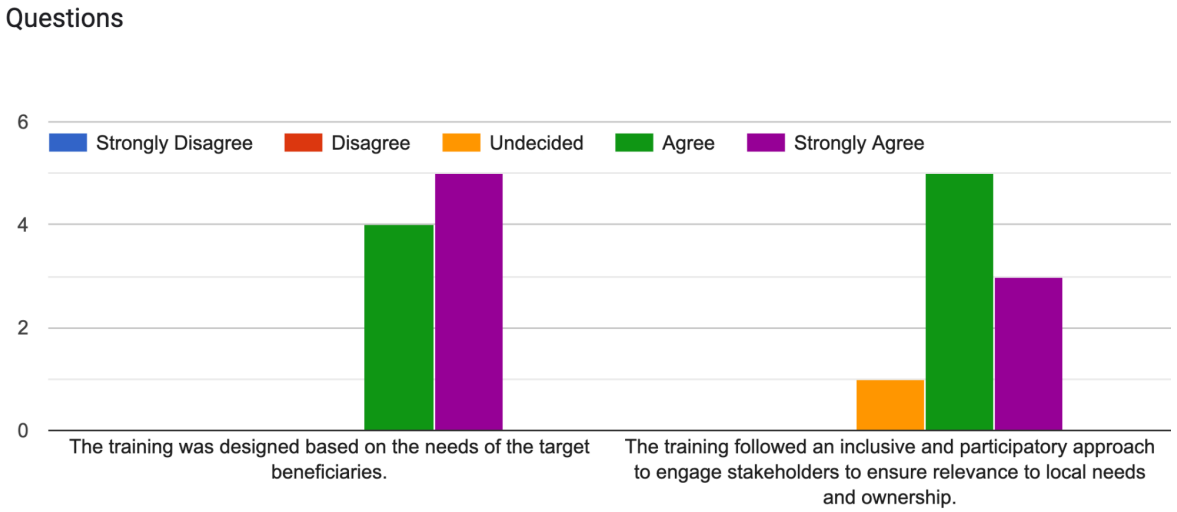
Training help to extract the data and reuse it for various purposes (eg for climate analysis)

Yes, this training program will have to understand the DataEx very well

More practical Session

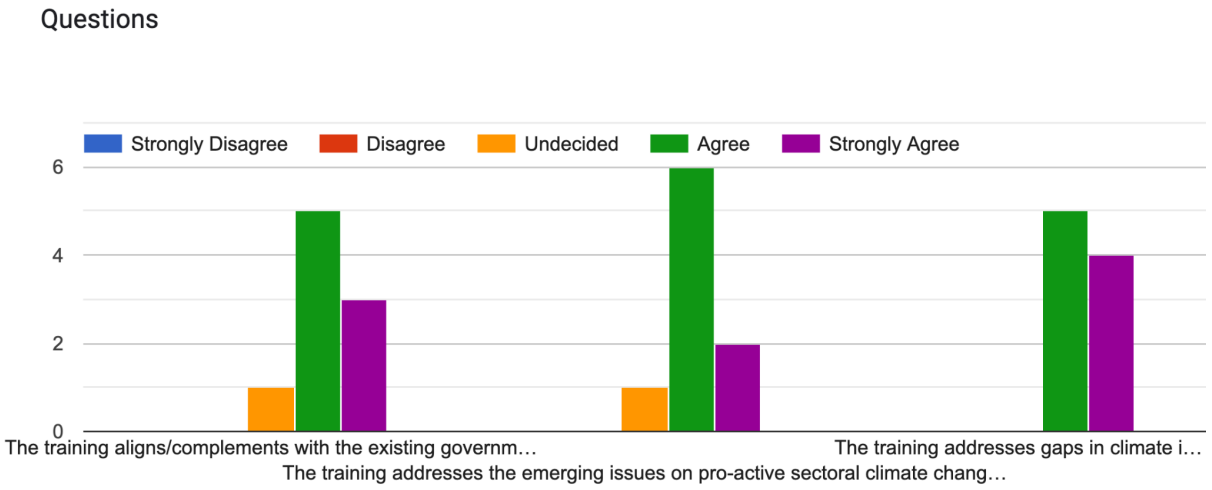
PARTICIPANT SATISFACTION

Relevance:



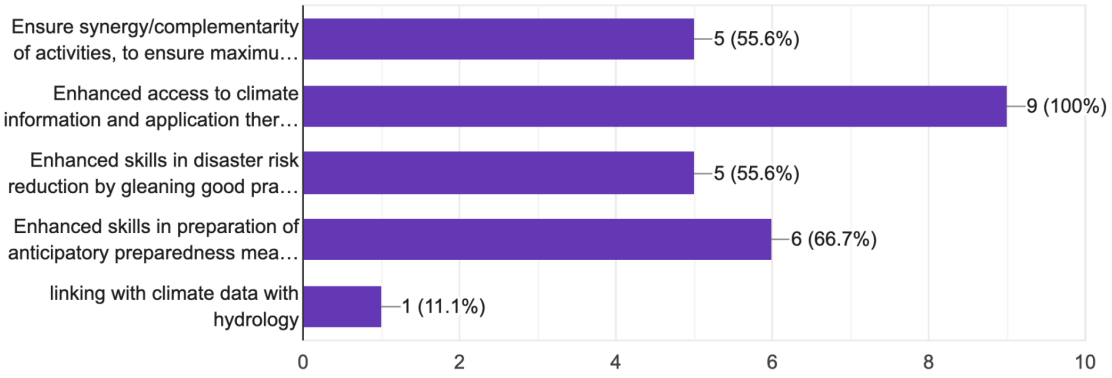
Comment: “Overall training arrangement and contents covered within the limited time period was very good”

Coherence:



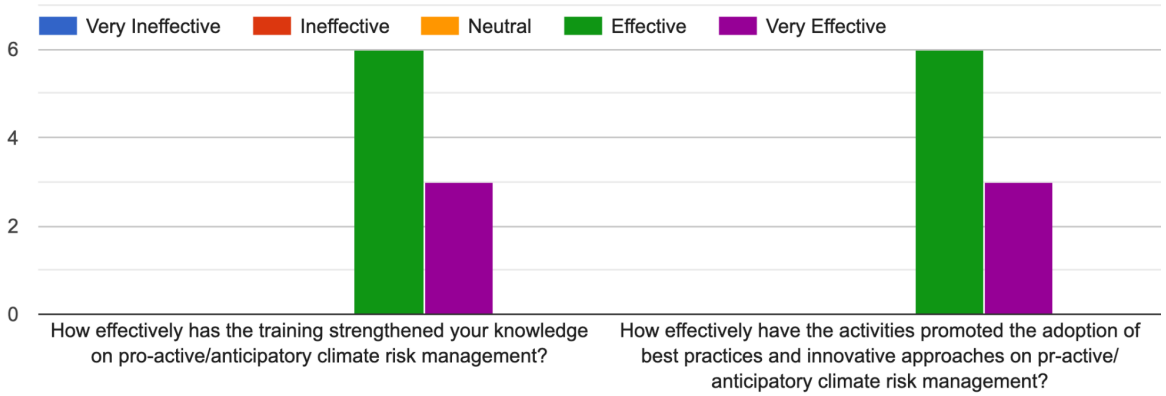
Please specify how the training is complementing/contributing to other programs, projects, and activities vis-a-vis climate information application in plans and decisions:

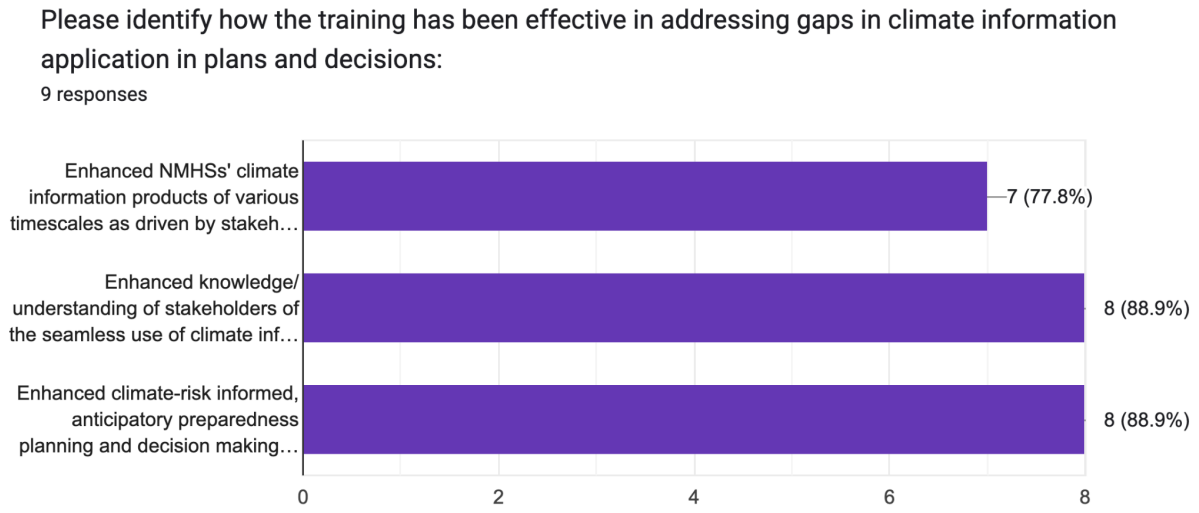
9 responses



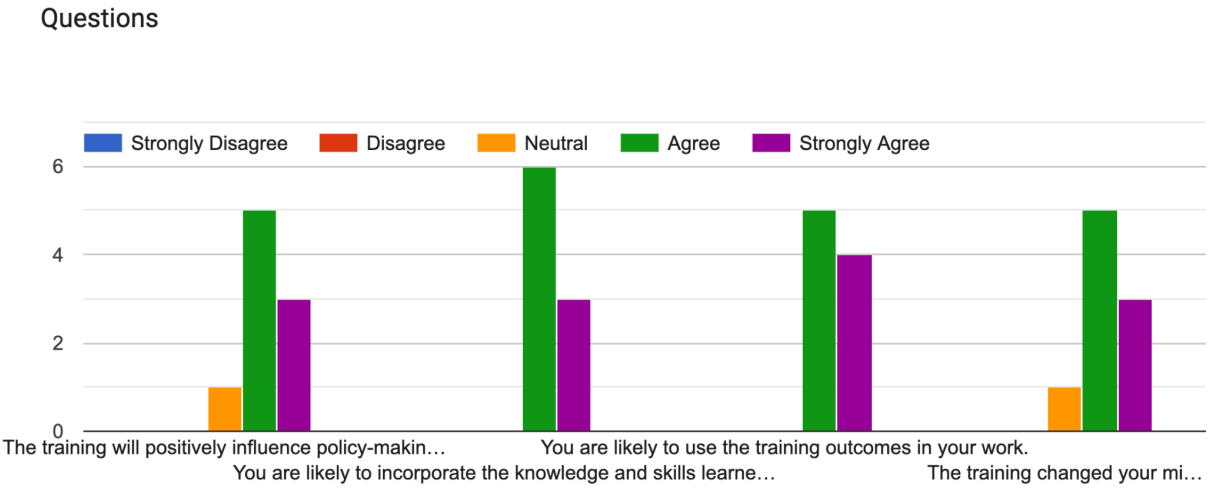
Effectiveness:

Questions



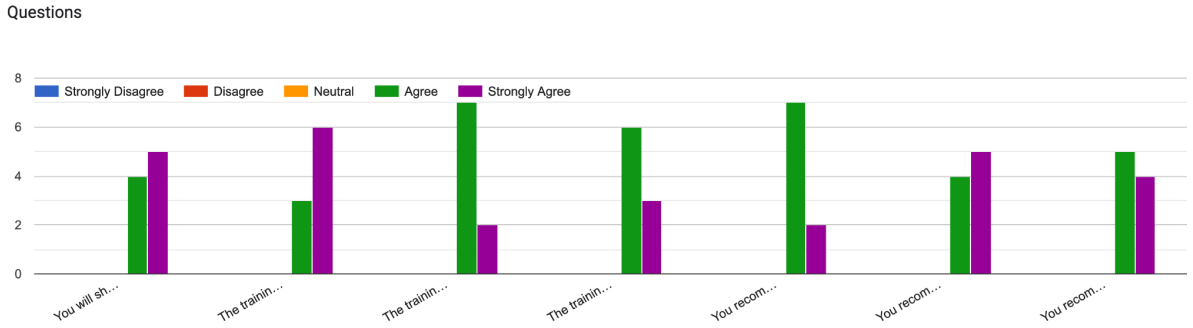


Impact:



Comment: “Arrange 3 days training on DataEx so that participants are familiar with DataEx”

Sustainability:



Comment: “For sustainability, it needs continue of training for same participants”

What went well? What areas need to be improved?

The training was thorough

Time allocation can be increased. Python basic may be added

Got understanding on the Knowledge Hub

Hotel, food, and the organizing ones very good

WG-NWP of SAHF was successful to fulfill its objective. Improvement required to be mentioned is none specific.

Everything went well. SKHub and DataEx is a new platform. Each topic is unique. DataEx needs to be more care.

Need to try to simplify manual code editing by users

About DataEx, besides ECMWF, other data sources are needed to added more for compare

I think, this training programme has captured almost every things

Organization and logistics was excellent

Good training and interactive sessions

What insights/opportunities have you gained from this training?

Using various types of climate data for specific application

Trained knowledge to integrated weather/climate information in the area of weather forecasting/climatic information dissemination.

DataEx and how important and potential it has!

Effective data sharing

Through this training, I gained the idea about SKHub, which will help me to improve my knowledge in various aspects of forecasting. DataEx will improve my forecasting capabilities.

Learnn more about python and linux

Analysis of data

I have gained some knowledge of Data Exchange platform. It will be for future activities.

Detailed information on various software platforms

What recommendations can be made for enhancing subsequent trainings?

The training needs to be continued for sustainability in long run, technology transfer and capacity building

Programming sessions/lectures, theoretical lectures could also be added in the upcoming trainings. In addition, countrywise training is also highly appreciated

Select participants based on experience

A detail training by RIMES to individual NMHS's officials

Allocate more time on hands on training on DataEx. Observed data visualization for the region make available so that forecasters get idea surrounding ____

1. More practical sessions

2. Specify required knowledge/skills for better understanding

A short refresher course (1-2 days) can be arranged at the organization level

My recommendations are: 1) arrange regular training programme, 2) develop knowledge sharing the latest technologies

It good to make sure that all datasets cover all the geographical area of the member countries