

MASTER PLAN 2026 - 2030

Building capacities throughout the climate information and early warning value chain for climate- and disaster-resilient development



PREFACE

In 2021-2025, RIMES Member Countries¹ demonstrated its commitment to the operationalization of all the five distinct but interconnected pillars of the climate information/early warning value chain through the implementation of the 3rd Master Plan (2021-2025). This period proved challenging as the whole world struggled to cope with the COVID-19 pandemic and the necessary lockdowns and restrictions. During this time, many countries also experienced extreme weather events which highlighted their vulnerabilities to compound hazards (climate hazards, including cyclones, floods, heatwaves, droughts, fires, etc., intersecting with the COVID-19 outbreak).

Amidst the unprecedented impacts, RIMES, from its Regional Multi-hazard, Multi-scale, Multi-purpose Early Warning Center, rose above the challenges by continuing to support its member and collaborating states in enhancing preparedness for, responses to, and mitigation of hydrometeorological hazards, sealing RIMES' relevance and capacity to build climate and disaster resilience.

RIMES came out from the pandemic as resilient, able to adapt to ever-changing work environments. RIMES continued delivering innovative solutions across the five pillars of the early warning information value chain:

- 1) Enhancing Data Availability and Accessibility
- 2) Modeling and Forecasting
- 3) Translating Data into Actionable Information
- 4) Tailor-made Services for Integrating Information into User Stakeholder Institutions
- 5) Community Outreach and Feed-back Driven System Refinement

Building on the significant outcomes of RIMES' Integrated Program from 2009 to 2021, RIMES deepened and expanded its programs through to 2025, with the technical and financial support from development partners. These efforts focused on countries with varying levels of capacities but facing common challenges due to shared risks, riverine systems, and socio-economic vulnerabilities. RIMES continued to expand its software services with the development of more systems and tools including:

- i. Climatic/Hydrometeorological Data Sharing (DataEx), a dynamic platform that enables secure exchange of country-specific meteorological data (archived station dataset with metadata and real-time data) as well as access to ECMWF's high-resolution forecast products;
- ii. Regional Resilience Data and Analytics Service (RDAS), a cloud-based, open-access platform combining climate and sectoral data with analytics capacities to inform policy, planning and investment decisions in the region.

The RDAS is linked to National Decision Support Systems (DSS) to enable climate sensitive sector user institutions such as DRM, agriculture, ocean/marine, health and water sectors, planning, finance and infrastructure sectors, to transform NMHS's hazard forecast data into potential Impact-based Forecasting (IbF).

¹ RIMES Member States are those countries who signed RIMES Cooperation Agreement and participate in both MEMBER STATE Segment and Program Segment of RIMES Council Meetings. Collaborating Countries are those who are yet to sign RIMES Cooperation Agreement and participate only in the Program Segment of RIMES Council Meetings. The term RIMES Member Countries connote inclusion of both RIMES Member States and Collaborating Countries. Ministers and Senior Officers of all RIMES Member Countries participate in Ministers Conferences.

RIMES serves as the integrator of World Bank-supported South Asia Hydromet Forum (SAHF). SAHF facilitates collaboration among NMHS and user sector institutions for co-production of IbF DSS/Climate services at the country level.

With RDAS through SAHF institutional mechanism, RIMES operationalized the **Regional Multi-hazard, Multi-scale, and Multi-purpose Early Warning Center** in 2024 to extend IbF and climate service delivery to all 9 countries in RIMES South Asia sub-region.

RIMES recognize the need to deepen its program in South Asia sub-region, replicate the best practices to other countries and sub-regions, and expand improved capacities across the climate information and early warning value chain through the Master Plan 2026-2030.

RIMES's 61 Member Countries - both 22 Member States and 39 Collaborating Countries - have been requested to contribute to / and draw from RIMES Regional Early warning /Climate services through 4th Master Plan 2024 -2026.

I am pleased to introduce the RIMES' Master Plan 2026-2030, which sets the direction and priorities of RIMES work over the next five years. Prepared by the RIMES Member Countries, the Plan aims to contribute to the Early Warning for All Initiative (EW4All) within the WMO-RIMES Joint Strategy and Action Plan (JSAP) framework.

The Plan presents priority actions identified by Members of the RIMES Council under each priority area through a country-led Master Plan development process. Each country is primarily responsible for mobilizing resources for Master Plan implementation. RIMES will assist countries to design projects in each country and facilitate Master Plan implementation by tapping technical expertise available within each country.

Monitoring and evaluation of Master Plan implementation shall be undertaken by RIMES, using a set of performance indicators.

I trust in each Member Country's proactive and active involvement and participation in realizing our aspirations for socio-economic development that is climate- and disaster-resilient. To our technical and development partners, we look forward to another meaningful collaboration and support in the coming 2026-2030.

Dr. M. RAVICHANDRAN

Secretary, Ministry of Earth Sciences, Government of India Chair of the RIMES Council

April 2025

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ABBREVIATIONS

AP	Active Participant
ASEANCOF	Association of Southeast Asian Nations Climate Outlook Forum
BANCAC	Bangladesh National Climate Information Application Center
CARE	Climate Adaptation and Resilience for South Asia Project
DART	Deep-Ocean Assessment and Reporting of Tsunamis
DataEx	Data Exchange Platform
DG	Director General
DSS	Decision Support System
ECMWF	European Centre for Medium-Range Weather Forecasts
EWS	Early Warning System
FCDO	Foreign, Commonwealth and Development Office
GPS	Global Positioning System
GTS	Global Telecommunication System
IBF	Impact-Based Forecasting
IMD	India Meteorological Department
IRU	IMD-RIMES Unit
JSAP	Joint Strategy and Action Plan
LDC	Least Developed Country
LLDC	Landlocked Developing Country
MMM	Multi-Hazard, Multi-Scale, Multi-Purpose
NCEP-GFS	National Centers for Environmental Predictions – Global Forecast System
NCMRWF	National Centre for Medium Range Weather Forecasting
NEC	National Earthquake Center
NMHS	National Meteorological and Hydrological Services
NTWC	National Tsunami Warning Center
PNG	Papua New Guinea
PP	Passive Participant
PRECISE	Portal for Regional Estimation of Coastal Tsunami Impacts using Sea-Level and Earthquake Information
PrP	Proactive Participant
RIMES	Regional Integrated Multi-Hazard Early Warning System
SADC	Southern African Development Community
SAHF	South Asia Hydromet Forum
SASCOF	South Asian Climate Outlook Forum
SIDS	Small Island Developing States
SLNCAC	Sri Lanka National Climate Application Center
SMS	Short Message Service
UKMO	UK Meteorological Office
UNEP	United Nations Environmental Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UTC	Coordinated Universal Time
USAID	United States Agency for International Development
WMO	World Meteorological Organization
WRF	Weather Research and Forecasting

INTRODUCTION

RIMES Master Plans guide the design and implementation of projects based on the preferences, needs, and demands of each country. The current RIMES Master Plan (3rd Master Plan: 2021– 2025) will conclude on 31 December 2025.

RIMES is pleased to introduce the Draft 4th RIMES Master Plan (2026-2030), which outlines the direction and priorities of RIMES' work over the next five years. This plan will contribute to the National NMHS's current and future Country Plans as well as the WMO and RIMES Joint Strategy and Action Plan (JSAP). A copy of the JSAP is attached.

The Master Plan aims to assist and draw from RIMES Member Countries, i.e., both Member States and collaborating countries, to contribute to RIMES Regional Early Warning Systems within JSAP framework.

RIMES 4TH RIMES MASTERPLAN (2026-2030)

With valuable contributions from the Government of India, Danish International Development Agency (DANIDA), the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), United Nations Environment Programme (UNEP), United Kingdom Meteorological Office (UKMO)/ Foreign, Commonwealth and Development Office (FCDO), United States Agency for International Development (USAID), the World Bank, and other humanitarian and development partners, RIMES has incrementally developed its Regional Multi-hazard, Multi-scale, and Multi-purpose Early Warning Center² and RIMES 4th Master Plan will leverage services from it considering following:

i. Economies of Scale

Limited-resource countries particularly Small Island Developing States (SIDS), Least Developed Countries (LDCs), Landlocked Developing Countries (LLDCs), and other developing states achieve economies of scale through shared resources, expertise, tools, and infrastructures. RIMES Regional Early Warning Center allows countries of various capacities to draw from and contribute to the system optimally and cost-efficiently.

ii. Advanced Technologies

One of the challenges that most of SIDS/LDCS/LLDCS and other developing states face is to keep pace with the ever-changing technological advancements and harness their potential benefit. RIMES Early Warning Center addresses this gap to offer advance data and analytics services through its Regional Data Center. Participating countries could draw data, tools, and systems from the Regional Data Center to customize/deliver specialized services and products such as sector-specific, location-specific digital impact forecasting/climate services tools at marginal additional costs.

² A multi-hazard system ensures that early warnings account for diverse and interconnected risks, from hydro-meteorological events like storms and floods to geohazards such as earthquakes and tsunamis, and are ready to be scaled up to meet potential biohazards threats

A multi-scale system draws from and contribute to global, regional, national, systems through partnerships. Through these partnerships, it provides services across different space and temporal scales to provide demanded services – from immediate short-term alerts to seasonal and long-term projections for national/ sub national / local applications.

A multi-purpose system expands the scope of early warnings beyond disaster response, supporting broader societal and economic resilience. By generating tailored climate services, it empowers diverse sectors to undertake proactive decisions to anticipate and manage extreme weather events (weather scale); harness benefits associated with favorable weather/climate resources (weather/sub-seasonal/seasonal climate scales), while informing development plans (multi-seasonal/decadal scale); and reduces disaster risks and supports economic vitality for resilience.

iii. Connectivity of all the Components of the Climate/Early Warning Information Value Chain

Investments/engagements from development partners are frequently compartmentalized to one or two specific pillars of the climate services/early warning information value chain. RIMES integrates these compartmentalized investments – from the upstream domains of scientific/technical capacity building (e.g. observation data availability/accessibility, modeling and forecasting) to the downstream domains of transforming data into tailor made climate/early warning information and enhancing capacities of user sectors institutions and communities to anticipate and manage risks – with small additional investments.

iv. Delivery of Common but Differentiated Services

RIMES offers a portfolio of services tailored to the differential requirements, demands, and capacities of countries at different stages of development.

v. Sustained Backup Support

Sustainability of interventions in climate services/early warning information value chain in capacity/resource-challenged countries require sustained backup support in specialized domains such as data generation and analysis, software/digital tools enhancements, refinement of models, integration of new/advanced technologies, and human resources capacity enhancement through co-development of systems/information products. RIMES provides this sustained backup support to maximize gains from development interventions in climate services/early warning information value chain.

vi. Intergovernmental Mandate and Ownership

The RIMES Council, comprised of Heads of NMHSs and are accountable to RIMES Member Countries and Country Stakeholders, ensures collaborative undertakings that are responsive to the differential requirements of Member States and

Collaborating Countries. The operational context of the heads of NMHSs, enriched with feedback from respective national stakeholder/user sector institutions on demanded services/information products, steers the direction of the RIMES Early Warning Center.

Among RIMES' key programs are the World Bank-supported Climate Adaptation and Resilience (CARE) for South Asia Component 1 and South Asia Hydromet Forum (SAHF)³. Appendix 2 elaborates details of CARE Component 1 and SAHF. CARE and SAHF, together, respond to all the pillars of the climate services/early warning information value chain.

The World Meteorological Organization (WMO), noting the salience of RIMES programs and the centrality of NMHSs in these programs, formalized its priority engagements with RIMES, via the WMO-RIMES Joint Strategy Action Plan (JSAP). The JSAP anchors on enhancing the capacities of NMHSs and translating these capacities into socio-economic and other tangible benefits. The instrument - considering the evolving context of opportunities, risks, science, technology, and therefore user requirements – calls for updating of the same, as necessary.

With the growing demands from its Member States and Collaborating Countries to deepen CARE Component 1/SAHF initiatives in South Asia, and to replicate best practices to other sub-regions, viz.: Africa, Southwest Indian Ocean, Middle East, Central/Southeast Asia, and the Pacific, the JSAP provides a conducive framework.

3 SAHF, operating with various funding streams and transcending various projects, has been part of CARE Component 1 since May 2023.

The period from 2025 to 2030 is a critical window for RIMES Member States and Collaborating Countries of varying capacities but exposed to common challenges driven by increasingly frequent extreme events. With more pronounced variability of natural hazards, the increased vulnerabilities from these natural hazards, the pockets of good practices and lessons that can benefit broader societies, and the unprecedented rate of technological advancements, the need for cross-national collaborations and cooperations, anchored on RIMES Regional Early Warning Center, has never been more vital.

The value of RIMES Early Warning Center that is multi-hazard, multi-timescales, and multi-purpose (Triple M) is elaborated in the document “Policy Incentives and Economic Rationale for Investing in Multi-Hazard, Multi-Timescale, and Multi-Purpose Regional Early Warning Systems to Supplement National Efforts” (in Appendix 3). The document, prepared by RIMES in collaboration with UNESCAP, identifies three key interconnected benefits (Triple Dividend) from investments in Regional Triple M Early Warning Center, viz.:

- risk management, where losses from extreme events are reduced
- resource management and optimization, where resources are efficiently used to maximize gains from favorable weather conditions while informed decisions are also undertaken for development planning
- enhanced resilience, where disaster risks are strategically and tactically reduced, while development and economic benefits are stimulated

The achievements of CARE Component 1 and SAHF contribute to the WMO-RIMES JSAP.

The RIMES Master Plan 2026 – 2030 offers a portfolio service to meet the requirements of RIMES Countries and will be implemented within the framework of the WMO-RIMES JSAP. The RIMES Master Plan 2026 – 2030 is designed to leverage RIMES’ Triple M and Triple Dividend Regional Early Warning Center’s technical resources for the benefit of RIMES Member Countries.

SERVICES PORTFOLIO

RIMES anchors its services on the five distinct – but inter-connected – pillars of the climate services/early warning information value chain viz.: 1) enhancing data availability and accessibility; 2) modeling and forecasting; 3) translating data into actionable information; 4) societal engagement and feedback; and 5) research and development. The details of the climate/early warning information value chain are provided in Figure 1 and subsequent short description.

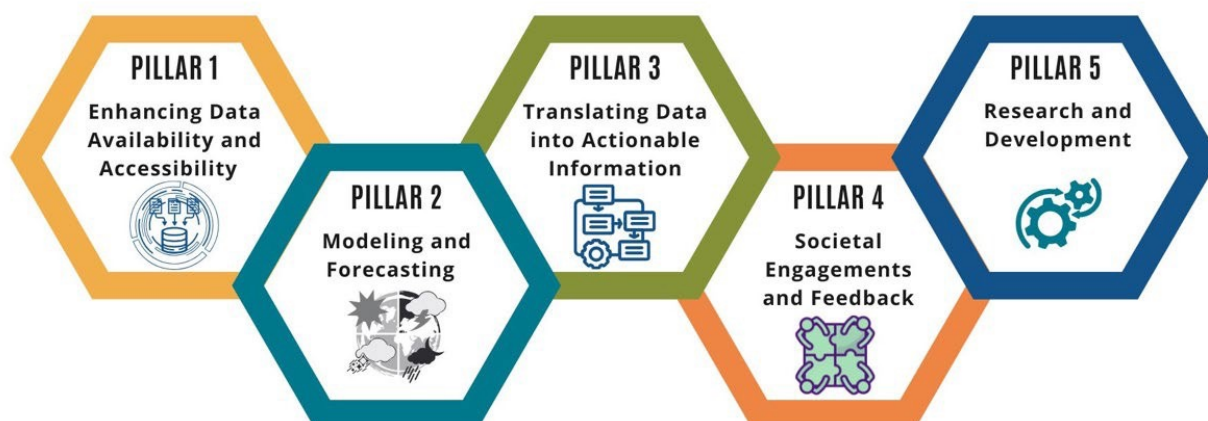


Figure 1. The five pillars of the early warning information value chain

PILLAR 1: DATA AVAILABILITY AND ACCESSIBILITY

a) Data Availability

RIMES' focus is two-pronged to maximize data availability for its Member States and Collaborating Countries: i) facilitating establishment/upgrading of observation stations⁴; and ii) development and upkeep of global/regional digital platforms for cross-country multi-hazard observation data sharing.

b) Data Accessibility

RIMES makes quality-checked observation data accessible to its Member and Collaborating States. Non-Global Telecommunication System (GTS) data sharing, among participating NMHSs, is pursued via the Data Exchange (DataEx) platform, a digital hub for sharing/accessing, curating, archiving and visualizing observation data. Weather/climate observation data are shared with the European Center for Medium Range Forecasting (ECMWF), and Indian National Center for Medium Range Weather Forecast (NCMRWF) for utilizing observation data in model enhancement.

For geohazards, RIMES leverages real-time earthquake and water level observation data from its established seismic and sea level monitoring stations, with real-time observation data from regional/global centers, to improve the estimation/validation of earthquake and tsunami events.

PILLAR 2: MODELLING AND FORECASTING

RIMES leverages weather/climate forecast data from ECMWF, NCMRWF and various other global/regional centers and generate customized downscaled and value-added forecast data as per country context and shares with each country. Moreover, RIMES enhances capacities of NMHSs to tailor/downscale/enhance forecast data for their country contexts through trainings.

To enhance collaborative engagements among NMHSs to address weather/climate forecast accuracy/customization, RIMES facilitates/provides technical support to the South Asian Climate Outlook Forum (SASCOF)⁵, the Association of Southeast Asian Nations Climate Outlook Forum (ASEANCOF)⁶, and the South Asia Hydromet Forum (SAHF)⁷. SAHF established the Weekly Forecasters' Forum to facilitate collective expertise/knowledge/insights and experience sharing, and forecast refinement among operational meteorologists.

RIMES provides 24/7 earthquake monitoring and tsunami early warning advisories for the reference of NECs/NTWSs, upon receipt of country demands.

⁴ These include telemetered seismic, sea level, deep ocean, weather, water level, and agro-meteorological observation stations/systems.

⁵ South Asian nations, supported by the WMO, came together to establish the SASCOF in 2010. Since then, SASCOF sessions are organized every year before the summer monsoon season, while winter sessions are organized from 2015 per stakeholders' demand.

⁶ The ASEANCOF, established in 2013, provides a regular platform for collaborative development, among Southeast Asian nations, of seasonal climate outlooks and related information for the region.

⁷ SAHF – involving the 8 countries in South Asia, and Myanmar, and with support from the World Bank and WMO – was established in 2018 to strengthen regional collaboration to address common and differentiated needs of NMHSs. In 2019, the SAHF Executive Council (EC), via SAHF II, was established to define the strategic direction of SAHF. The SAHF EC is comprised of the Heads of NMHSs in the region; RIMES is the SAHF Secretariat.

PILLAR 3: TRANSLATING DATA INTO ACTIONABLE INFORMATION

a) Institutional Mechanisms

RIMES established the National Seasonal/Monsoon/Climate Forums as a first-generation platform for co-production of early warning-informed decision guidance products between NMHSs and sectoral institutions (includes agriculture, water resources, disaster risk management, etc.). RIMES have been facilitating the transformation of these Forums into formal national institutional mechanisms through the signing of Memoranda of Agreement/Understanding (MoAs/MoUs) for data sharing and coproduction of Decision Support Systems (DSSs)⁸. The IMD-RIMES Unit (IRU) for impact forecasting in India, the Sri Lanka National Center for Climate Application (SNCCA), and the Bangladesh National Center for Climate Application (BANCCA) are in operation. RIMES will engage with the countries to establish such formal institutional mechanisms to facilitate the coproduction of Impact Based Forecasting/Climate Services as an integral part of the RIMES Master Plan implementation.

Earthquake and tsunami preparedness are integrated into National Seasonal/Monsoon/Climate Forums for sustainable, multi-hazard approach.

b) Tailor-Made Decision Support Systems

Bringing together NMHSs/NTWCs/NECs and sectoral institutions, RIMES co-develops and operationalizes user-driven digital DSSs to generate Impact Based Forecast/Climate services. Currently, these DSSs are available for disaster risk management, agriculture, and water resources, health, livestock, planning, and transport sectors. These digital systems translate different timescales of weather/climate data into actionable information for sector-specific decision-making. Information products/outputs from DSSs are further tailored to ensure best fit solutions that address variable information requirements of different users institutions/communities, communicate uncertainties, and disseminate decision guidance information efficiently to drive decisions/actions by end user institutions/communities.

PILLAR 4: SOCIETAL ENGAGEMENTS AND FEEDBACK

RIMES facilitates mechanisms for empowering local institutions and communities through actionable risk information and two-way interaction for enhanced resilience. RIMES adopts a unified user-centric approach that combines the overall enhancement of national institutional frameworks underpinning DRR/DRM planning, emergency response, and disaster reporting, with robust context-driven last-mile communication and feedback mechanisms.

RIMES supports the national frameworks for climate services and provides feedback to authorities for identifying and addressing gaps in the climate services/early warning information value chain through capacity building on end-to-end early warning at all levels. RIMES links vulnerable groups to available institutional resources and services for adaptive response with the goal of strengthening resilience and preparedness. RIMES facilitates customization of DSSs and demonstrations at the community level to ensure that information reaches communities timely and is acted upon to undertake forecast-based actions.

RIMES enhances capacities at all levels: early warning agencies to generate user-tailored forecast products and services, and end-users to receive, understand, and internalize forecasts and warnings through improved dissemination of impact forecasts and risk management advisories of various timescales (in Figure 2).

⁸ As with any system, the DSSs require life-long work to constantly fine-tune them to evolving advances in science and technologies, risks and opportunities profile, and user requirements.

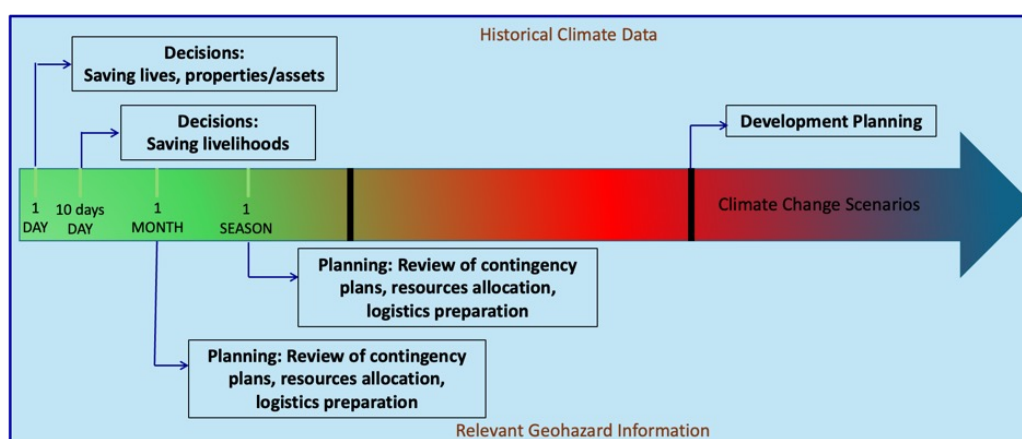


Figure 2. Societal engagements capacitate sectoral institutions/end users in nuanced application of multi-hazard decision guidance products, ranging from decisions that need to be undertaken most immediately to long-term development planning. These societal engagements also serve as an effective feedback loop, to regularly steer products and services to dynamic stakeholder's requirements.

These institutional and community engagements also serve as robust feedback platform, for experience-based evaluation of decision guidance products by institutional/end users. To assess and address evolving societal demands and needs, RIMES adopts a user-centered bottom-up approach that focuses on the user needs and demands as a driving factor to guide the entire process of climate/weather service coproduction.

RIMES engages with both the service providers and end-users to create an enabling environment to sustainably deliver and integrate advanced early warning and climate products to meet societal needs.

PILLAR 5: RESEARCH AND DEVELOPMENT

RIMES undertakes research and development, focusing on delivering cutting-edge technologies and building capacity in innovative techniques and tools. Its research agenda prioritizes the development of cost-effective yet efficient solutions for improving accuracy, value addition, last-mile communication of advisories, and ensuring timely and appropriate responses by recipients. RIMES undertakes research in collaboration with national stakeholder institutions, to dynamically update/refine/upgrade the processes and products associated with Pillars 1 to 4. This includes applied research for development of high-resolution climate/weather models and integration of DRM/DRR and CCA into climate services/early warning information delivery, as well as demand-driven services like custom applications, toolkits, manuals, and SOPs for effective implementation of risk response.

RIMES MASTER PLAN IMPLEMENTATION PROCESS

The Plan outlines priority actions for each member country to identify under the respective priority areas, as indicated in the column 5 of the appended table below (Appendix 1).

Each Member country could align their National Plan priorities with the Master Plan Menu of services and indicate other priorities that could cater to their needs as identified in their National Plan priorities. As well, each country is free to choose any service from the menu of services that is not captured in their current National Plan but is actually needed for enhancing NMHS service delivery along all 5 pillars of climate information/early warning information value chain as per Reference Document 1.

Therefore, each country is requested to review the priority areas presented in this Master Plan and complete the column 5 (Country Preferences) of the appended table (Appendix 1), indicating preferred actions for 2026–2030.

Member countries are responsible for mobilizing resources to implement the Master Plan at the national level.

Resources for Master Plan Implementation could come through these three distinct but interconnected sources:

1. Member Country Annual Budgets: Member Countries as Proactive Participant (PrP) integrates Master Plan priorities into their Annual Budgets.
2. 2. Donor-Assisted Projects at the Country Level: Member Countries as Active Participant (AP) ensure that RIMES Master Plan priorities are integrated into Donor/Development Partner-Assisted Projects with RIMES as an Implementing Partner.
3. 3. Development Partner-supported Regional Projects: Member Countries as Passive Participant (PP) participate in the RIMES-Implemented Development Partner-supported Projects.

In addition, the resourceful RIMES Member States/Collaborating Countries who are participating in RIMES Programs/RIMES Council/Ministers' Conferences could assist other RIMES Countries to implement RIMES Master Plan through financial instruments.

The RIMES Member Countries have been leveraging resources to implement Master Plan Priorities through one or a combination of the above three sources. Notable examples are:

- **Category 1** (Proactive Participant): India
- **Category 2** (Active Participant): Bangladesh, Maldives, India, and Timor-Leste
- **Category 3** (Passive participant): Afghanistan, Bhutan, Cambodia, Fiji, Lao PDR, Myanmar, Nepal, Pakistan, PNG, Myanmar, Nepal, Samoa, and 16 Countries - Angola, Botswana, Comoros, Congo, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Tanzania, Zambia and Zimbabwe - through the Southern Africa Development Community (SADC) Climate Services Center under WMO Regional Program implemented by RIMES.

Based on above experiences, Member Countries could draw appropriate strategy for their respective country. Each country could indicate potential funding source against chosen priority in column 6 (Potential Funding Source) of Appendix 1. RIMES encourages countries to be in either PrP or AP Category or both on rather than PP category to ensure country-owned and country-led implementation of projects based on countries' perceived needs.

RIMES will provide catalytic technical support to assist countries mobilize resources in collaboration with National Meteorological and Hydrological Services (NMHSs), sectoral agencies and technical partners. Moreover, RIMES will assist countries in formulating and executing relevant projects and programs.

Recognizing that member countries possess different levels of capacity, especially in technical and financial areas, RIMES will adopt a phased and supportive approach to promote each country's participation in executing the Master Plan:

- **Support for Resource Mobilization**

While countries are expected to take the lead in mobilizing resources for their prioritized actions, RIMES, through the Program Unit, will assist in preparing funding proposals, collaborating with development partners, and identifying joint investment opportunities to complement national efforts.

- **Country-Specific Engagement**

Based on existing collaboration and assessed needs, RIMES will implement programs according to the priorities determined by each country.

- **Phased Roll-Out**

The Master Plan allows for flexibility in implementation timelines, enabling countries to progress at a pace that reflects their context, priorities, and available resources.

- **RIMES Council**

All participating countries involved in Master Plan Implementation will be invited to the Annual RIMES Council meetings to report and discuss program implementation and experiences and recommend improvements in program implementation. Progress in achieving the recommended improvements will be reported during the subsequent RIMES Council Meetings.

- **RIMES Ministers Conference**

All Ministers in charge of NMHS / Stakeholder Ministries will be invited to once un 3 years Ministers Conferences and Master Plan implementation experiences will be discussed in the Conference and recommendations will be implemented and reported to subsequent Ministers Conferences.

TIMELINE

Each Country is requested to indicate the name of their country at the top of table, fill in Column 5 and Column 6 of the tables in Appendix 1, and submit the duly filled-in document to the Director General (DG) of RIMES on or before 4th April 2025 . RIMES will share updated Master Plan on 6th April ,2025 for discussion on 7th April .

Countries could present it in the 17th RIMES Council Meeting (7th May 2025) and Ministers or the Head of Country Delegation, on behalf of Ministers, could make a statement in the agenda under the 4th Master Plan (2026 -2030) in the 4th Ministers Conference (8th and 9th May 2025).

RIMES Team will work with focal point of each Country and develop a project that will indicate identified country priority

The endorsement of the RIMES Master Plan 2026-2030, and its contribution to WMO and RIMES Joint Strategy and Action Plan (Annex 1), shall be reflected in the 2025 DRAFT DECLARATION (9th May 2025).

This MASTER PLAN IS A LIVING DOCUMENT that will be PERIODICALLY and DYNAMICALLY UPDATED throughout implementation period and shared with Countries.

APPENDIX 1. RIMES MEMBER COUNTRIES' PRIORITIES AS INPUTS TO THE 4th RIMES MASTER PLAN (2026-2030)

NAME OF THE COUNTRY : ---

PILLAR 1: ENHANCE DATA AVAILABILITY AND ACCESSIBILITY					
	Products/ Systems/ Services	Services/ System Description	Countries currently receiving support from RIMES	Country Preferences	Potential Source of funding Sources 1. Country Annual budget 2. Country Specific Donor/ Development partner supported project 3. Regional Project in which Country is/will be participating
DATA AVAILABILITY: Enhancement of observation systems by establishing and/or upgrading observing stations. These include telemetered seismic, sea level, deep ocean, weather, water level, and agro-meteorological observing systems.					
Marine Observation	Marine Wave Buoy	Crucial data collection and real- time ocean surface condition data transmission for monitoring wave and swell activity.	Seychelles Timor-Leste		
	Tide Gauges & Sea Level Station	Observation Stations for Monitoring of Sea-Level Trends and Validation of Tsunami Early Warnings.	Philippines Thailand Vietnam		
Surface Weather Observations	Automatic Weather Station (AWS)	Extreme Weather Forecasting using low-cost Early Warning Systems (EWS) and communication equipment	Bangladesh, Maldives, Myanmar, Nepal, Pakistan, Philippines		

	Automatic Water Level Station (AWLS)	Real-time monitoring of water levels, providing vital data for flood prevention, irrigation planning, and hydrological studies.	Bangladesh Pakistan Sri Lanka		
Hydrological observation system	Discharge and Gauge Stations	Measuring river flow and water levels, providing critical data for flood forecasting, water resource management, and environmental monitoring.	Bangladesh Myanmar Nepal Philippines		
Earthquake Monitoring Observation System	Seismic Station	Monitoring and analyzing earthquake activity, assessing geological hazards, and supporting early warning systems to mitigate disaster impacts.	Bhutan Myanmar Nepal		
DATA ACCESSIBILITY					
Data Communication and Exchange System. This system shall be used in collecting, transmitting, and integrating data from various sources, and subsequently directing these data to their intended locations and uses	Marine/ Coast		Comoros Seychelles Sri Lanka Thailand Timor-Leste		
	Echosounder	Near-shore survey to collect the Coastal Digital Elevation Model (DEM)	Seychelles Thailand Timor-Leste		

	Earthquake	Automatic seismic data acquisition system: Antelope and SeisComP are used as redundant systems	Afghanistan, Bangladesh, Cambodia, Comoros, Djibouti, India, Kenya, Lao PDR, Madagascar, Maldives, Mongolia, Mozambique, Myanmar, Nepal, Papua New Guinea, Philippines, Seychelles, Somalia, Sri Lanka, Timor-Leste, Tonga, Yemen		
	DataEx	A web-based tool for data analytics and visualization; It is a platform for analyzing forecast data, including subset and region-specific analyses. DataEx incorporates observational data shared by RIMES member countries. The platform features a data collection mechanism, automated quality checks (QC), and integration of in-situ observation data from meteorological services in the region. It also offers access to the latest high-resolution forecast products from global/regional producing centers like ECMWF and India Meteorological Department (IMD).	Afghanistan, Bangladesh, Cambodia, Comoros, Djibouti, India, Kenya, Lao PDR, Madagascar, Maldives, Mongolia, Mozambique, Myanmar, Nepal, Papua New Guinea, Philippines, Seychelles, Somalia, Sri Lanka, Timor-Leste, Tonga, Yemen		

	DataEx	DataEx includes several engines that enable meteorological services to compute forecast and observed data for specific locations or basins instantly. With its graphics engine, users can generate regular forecast products for operational use. Furthermore, met services can utilize API services to automate data processing and graphic generation processes. DataEx Platform is also used to undertake forecast verification and provide feedback to global/regional forecast producing centers such as ECMWF			
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PILLAR 2: MODELING AND FORECASTING

For NMHS Weather / Climate Operations	Products / Systems / Services	Services / System Description	Available Services Across Countries	Country Preferences	Potential Source of funding Sources
					1. Country Annual budget 2. Country Specific Donor/ Development partner supported project 3. Regional Project in which Country is/will be participating
	Short-range Forecast: RIMES-WRF	RIMES' Weather Research Forecasting (WRF) model, originally developed at the U.S. National Center for Atmospheric Research (NCAR), is customized over the African and Asian regions for a horizontal grid spacing of 9x9 km, with 5-minute topography as one of the surface boundary conditions. The model uses US National Center for Environmental Prediction's Global Forecast System (NCEP GFS) products as initial and boundary conditions for generating daily weather information, with up to 84 hours lead time. Model configuration is as follows: Model domain: 19.43°E – 150.61°E 18.04°S – 50.87°N	Afghanistan Bangladesh Cambodia Comoros Djibouti India Kenya Lao PDR Madagascar Maldives Mongolia Mozambique Myanmar Nepal Papua New Guinea Philippines Seychelles Somalia Sri Lanka Timor-Leste		

		Horizontal resolution: 9km x 9km Initial conditions: - NCEP GFS analyses and forecast products Integration period: - 84 hours starting 12UTC daily Post processed outputs: - Wind and geopotential heights, temperature at standard levels, and rainfall	Tonga Yemen Madagascar Chad		
	MetStudio A suit of DSS for HNMS operations	Data Storage and Processing System (DataWorks) DataWorks is the centralized data storage, management, and processing system for NMHSs. Meteorological Forecasting System (MetWorks) MetWorks is a tool for integrating, visualizing and processing multiple data and models to produce meteorological forecasts and extreme weather warnings Aero-meteorological Forecasting Sytem (AeroWorks) AeroWorks is a system that generates ICAO-compliant meteorological information used by pilots and airlines during take-off, en-route and landing. It will be developed as part of	Timor-Leste		

		Ocean Forecasting System (OceanWorks) OceanWorks is designed to assist with ocean/marine modeling and forecasting. The system will be developed as part of MetWorks but can also be provided as a stand-alone system. Hydrological Data Management and Forecasting System (HydroWorks) HydroWorks is a hydrological data management platform as well as flood monitoring and forecasting system.			
	FOCUS (Forecast Customization System)	Multi-Model ensemble-based seasonal climate prediction system to prepare the probability forecast for the countries and regions	Afghanistan, Bangladesh, Bhutan, Brunei Darussalam, Cambodia, India, Indonesia, Iraq, Lao PDR, Malaysia, Maldives, Myanmar, Nepal, Pakistan, Papua New Guinea, Philippines, Samoa, Singapore, Sri Lanka, Thailand, Timor-Leste, UK (United Kingdom), Vietnam, Yemen		
	Storm surge inundation forecasting and warning system	A web-based system for evaluating inundation risks from storm surge potential of predicted cyclones. The system generates and disseminates surge and inundation risk maps and accompanying advisories, along with			

		forecasts of cyclone track, intensity and rainfall.			
Climate Change Data Analytical Services	CDAAS: Climate Data Access and Analytical Services	Climate Data Access and Analysis System (CDAAS) is a web-based system for access to and analysis of climate data and scenario products, for generation of downscaled projections for any area of interest within the RIMES domain. The system contains datasets from 8 Global Climate Models (CMIP5 GCMs), 6 models from NASA Earth Exchange (NEX), and 6 Regional Climate Models (RCMs) of the Coordinated Downscaling Experiment (CORDEX) South Asia. Each model data spans the period 1980-2005, representing baseline period, and future projections for the period until 2100. CDAAS also includes 2 future emission scenarios – RCP 4.5 (moderate) and RCP 8.5 (high). These datasets enable telescopic downscaling of climate baseline and projections, from coarse resolution GCMs (~180km) to downscaled information of up to ~25km, from multiple climate models, enabling development of robust climate change projections with uncertainty levels. The climate data analysis engine is capable of a variety of climatological analysis, including analysis of extremes.	Afghanistan, Bangladesh, Cambodia, Chad, Comoros, Djibouti, France, India, Kenya, Lao PDR, Madagascar, Maldives, Mongolia, Mozambique, Myanmar, Nepal, Papua New Guinea, Philippines, Seychelles, Somalia, Sri Lanka, Timor-Leste, Tonga, UK, Yemen		

Ocean Modelling	Localized Ocean Forecast Modelling (ROMS, WW3, TMD3)	Development of customized ocean modelling for location-specific ocean state forecast parameters and uses	Timor-Leste		
	Landslide Risk Modelling	Localized landslide modelling for early detection and alert generation	Timor-Leste Nepal		
	Lightning Nowcast	Real-time monitoring and forecasting of lightning activities with the generation of alerts	Bangladesh		
	Heatwave Portal	Real-time heatwave monitoring, forecasting, and alerts, offering critical data for public health advisories	Bangladesh		
	ShakeCast: online tool for rapid earthquake risk assessment.	RIMES customizes ShakeCast, a tool developed by the U.S. Geological Survey for estimating risks to population and critical facilities using real-/ near real-time data from an earthquake event. Potential damage information is sent to registered users by SMS, fax, and email. Bulletins are updated based on improved earthquake parameters for the event. ShakeCast customization uses exposure data at smallest administrative unit (e.g. village level population data and detailed building inventory) and appropriate building vulnerability functions	Ready for Pilot-Testing		
	INSPIRE: online tool for tsunami propagation and inundation simulation and risk assessment	RIMES' internet-based simulation platform for tsunami inundation and risk evaluation, named INSPIRE, is a web portal that provides modules for: identifying tsunami sources,	Pilot tested in Sri Lanka		

		simulating tsunami propagation and inundation, integrating exposure data, and performing tsunami loss estimation. The analysis modules are designed to handle multi-dimensional vulnerability data and different levels of data accuracy, allowing users to undertake preliminary tsunami risk assessment using available data, with progressive improvement in assessment results as more detailed and accurate datasets are used. INSPIRE outputs include tsunami inundation maps, showing maximum inundation depths, maximum flow velocities, and estimated tsunami arrival times; and tsunami loss estimates in terms of probability of casualty, probabilities of building collapse/ severe damage for different building types, and number of buildings that could be inundated at an inundation depth range for buildings of different construction and occupancy types.			
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PILLAR 3: TRANSFORMING DATA INTO ACTIONABLE INFORMATION VIA DECISION SUPPORT SYSTEMS / IMPACT-BASED FORECASTING DSS/TAILORED SERVICES

Area of Services	Products / Systems / Services	Services / System Description	Counties currently receiving support from RIMES	Country Preferences	Potential Source of funding Sources 1. Country Annual budget 2. Country Specific Donor/ Development partner supported project 3. Regional Project in which Country is/will be participating
Regional Data Analytics Support	RDAS (Regional Resilience Data and Analytics Services)	Consolidate open data and analytics relevant for climate-informed key sectoral policies, decisions, and investments	Bangladesh Pakistan Nepal		
	Climate Service Toolkit (CST)	Enhancing access and analysis to climate data from various sources (sub-seasonal to seasonal scale). The system uses global /regional products from ECMWF/IMD's CFSv2 coupled model (Atmospheric and Ocean model) for provision of extended range forecast outlooks for rainfall, and temperature with 4-week lead. The tool also integrates of sub-seasonal to seasonal forecast indices for sector users' application such as agriculture, public health and water resources.	Bhutan Angola (SADC) Burkina Faso (ECOWAS) Cameroon (ECCAS) Jamaica (Caribbean) Kenya (IGAD) Madagascar (IOC) Mauritius (IOC) Samoa (Pacific) Seychelles (IOC) Comoros (IOC)		

	Flood Impact Forecasting	<i>Flood Impact Forecasting</i> is developed to support efficient planning of the water resources and real-time operation and management for river monitoring and	Bangladesh Myanmar Nepal Pakistan	Has been piloted in few locations, need	
		management of water resources infrastructure. The tool assists the water management departments in handling flood situations more efficiently and ensure preparedness measures before each flood season. It also assists in reliable flood hazard, exposure and vulnerability assessments. Efficient flood and river management can be achieved through these data driven decision-making. The tool integrates data like road network, land use and population data to estimate the impact of different intensity of flood scenarios	Philippine Sri Lanka	scale up	
	Localized flood impact and Hazard Mapping	Customized flood Impact and hazard mapping for pilot locations	Thailand		

National Level Decision Support Systems	Agriculture Sector • SESAME	<i>Specialized Expert System for Agro-Meteorological Early Warning (SESAME)</i> is a web-based Decision Support System for generating and disseminating crop management advisories for specific crops at particular growth stage, based on weather and climate information at different timescales. SESAME maps crop sensitivity to a particular weather condition, processes how the predicted weather shall influence crop growth, and generates crop advisories using machine-learning algorithm. The system generates: real-/ near real-time or most recent observation data and weather information for the past decade,	Bangladesh Bhutan India Myanmar Nepal Pakistan Sri Lanka Timor-Leste		
		month, and season to aid understanding of current and recent historical weather condition; daily weather forecast, daily update of the pentads (five-day spells), and monthly and 3-monthly outlooks; information on the normal for the pentad, dekad, monthly, and 3-monthly climate; and crop management advisories, accompanying the forecasts and outlooks. The system has capabilities for disseminating bulletins via email, SMS, social media, and mobile app, as well as capability for receiving user feedback.			

	Livestock: • LAS	Livestock Advisory Service (LAS) is a Decision Support System (DSS) facilitates climate-resilient planning and management for the livestock sector, supporting sectoral departments in delivering effective livestock extension services. It allows real-time monitoring of extreme weather events with potential of affecting livestock resources, integrates multi-timescale multi-hazard risk information, auto generate advisory templates and disseminate to various user groups. The DSS assists in tactical management of livestock shelters, fodder production, disease control, vaccination etc. On the other hand, it provides strategic guidance on climate adaptation based on projected climate risk indicators for livestock.	Bangladesh		
	Water Sector • FloCast	A web-based platform providing basin discharge and river level forecasts, mapping flood risks, and delivering timely advisories for effective flood management.	Bangladesh Myanmar Nepal Philippines Sri Lanka	Nepal's Babai River and Sri Lanka's Kalu Ganga Basin.	
	Transportation • Navigate	A specialized system supporting stakeholders in climate-informed road planning and decision-making by providing guidance products for long-term strategies and short-range operational decisions.	Nepal		

	Ocean • OSFAS	A customizable web system delivering location-specific ocean forecasts, real-time data, automated advisories, and buoy tracking for marine management.	Maldives Seychelles Sri Lanka Timor-Leste		
	Tsunami DSS	The Tsunami Decision Support System (DSS) is a web platform providing automated earthquake and tsunami warnings, generating and disseminating alerts and bulletins. Utilizes data from observation networks and the RIMES tsunami database.	Afghanistan, Bangladesh, Cambodia, Comoros, Djibouti, India, Kenya, Lao PDR, Madagascar, Maldives, Mozambique, Myanmar, Nepal, Papua New Guinea, Philippines, Seychelles, Somalia, Sri Lanka, Timor- Leste, Tonga, Yemen		
	Health Sector • CRISH (Climate Risk Information System for Public Health)	<i>Climate Risk Information System for Public Health (CRISH)</i> is an advanced decision support system designed to enhance public health management by utilizing a deep learning approach that integrates location-specific climatology of weather parameters with historical health data. This innovative system combines multi-timescale weather forecasts, climate outlooks with historical data to predict and map potential outbreaks of climate sensitive diseases, specifically diarrhea, malaria, heat stroke and dengue. The system integrates real-time disease surveillance data shared by	India Timor-Leste		

		healthcare providers to support informed decision-making. Additionally, CRISH offers graphical analysis tools to visualize disease trends across various demographics, includes comprehensive details on healthcare facilities for resource allocation, features a medical transport network with ambulance contact information to facilitate swift emergency responses, and provides public health education resources.			
	DRR Sector • SATARK	<i>System for Assessing, Tracking and Alerting Disaster Risk Information based on Dynamic Risk Knowledge (SATARK)</i> is a web-based system for assessing potential impacts of a hazard using weather forecast information, and for evaluating, generating, and disseminating impact management options. The system also acts as a data management system for managing and processing weather, disaster risk, and emergency response resources data for resource allocation, rapid deployment, and management. The system generates and disseminates weather forecasts, forecast-based risk maps, and accompanying advisories. The system can visualize emergency response resource locations and quantities and can also display updates from the ground that are entered by registered users, thus allowing disaster managers to track	India Nepal		

		and manage ongoing emergency response.			
	• TNSMART	Tamil Nadu Multi-Hazard Potential Impact Assessment and Emergency Response Tracking (TNSMART) A web-based system leveraging real-time data from weather, satellites, and sensors to monitor, assess, and respond to hazards, offering a unified operational view and enabling effective multi-agency coordination.	India		
	• INSTANT	Integrated Forecast Dissemination Portal (INSTANT) is a web-based platform developed for sharing forecast products, risk and resource related information in an intuitive manner through iconography and customizable templates. The platform is used by met services for communicating impact-based forecasts by integrating real time data with exposure and vulnerability information from collaborating departments. The system is capable of automatically disseminating alert for major extreme events to its subscribers. It is widely used by disaster management organizations, I/NGOs, UN agencies for anticipatory actions and disaster preparedness in implementing member countries.	Bangladesh Nepal Pakistan Sri Lanka		
	Planning Sector • CLIM-PLANNed	Integration of climate information into development planning process to decide and implement climate risk informed development program.	Pakistan		

	• ESCAPE: online tool to support evacuation planning	RIMES' evaluation system for computing accessibility and planning evaluation, named ESCAPE, is a web-based system for mapping the shortest and fastest evacuation route toward safe shelters, with due consideration of topographic condition, land use, location of critical facilities, and population density, age, and gender. The system can also evaluate shelter capacity against expected number of evacuees.			
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PILLAR 4: TAILOR-MADE SERVICES FOR INTEGRATING INFORMATION INTO USER STAKEHOLDER INSTITUTION

For NMHS Weather / Climate Operations	Products / Systems / Services	Services / System Description	Counties currently receiving support from RIMES	Country Preferences	Potential Source of funding Sources 1. Country Annual budget 2. Country Specific Donor/ Development partner supported project 3. Regional Project in which Country is/will be participating
Climate Services USER FORUMS	Regional-Level Climate Outlook Forums	Connecting climate forecasters, hydrometeorological services, and users to assess climate outlooks and their impacts for better preparedness and decision-making.	Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri-Lanka Brunei, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Viet Nam, East Africa		
	South Asia Hydromet Forum	Bringing together experts and users to assess shared hydrometeorological challenges across borders, enhancing preparedness and collaboration.	Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri-Lanka		
	National-Level Climate Outlook Forums/ Monsoon Forum	A platform for user engagement that fosters interaction between stakeholders at the national and sub-national levels, enhancing the use of climate information and early warning systems.	Myanmar, Nepal, Pakistan, Sri Lanka, Bangladesh, Cambodia, Lao-PDR, Maldives, PNG, Bhutan		

	Forecast Provider-User Forums	RIMES assists countries in establishing Monsoon Forums, a national platform for forecast provider-user dialogue, which aim to: ensure that forecasts, including their uncertainties and limitations, are communicated to and understood by users; encourage forecast application for mitigating risks in various climate-sensitive sectors, including, but not limited to agriculture, water resources, disaster management, and health; receive user feedback for improving usability of forecast products; provide a platform for inter-agency coordination of policies, sectoral plans, and programs for dealing with potential impacts of hydro-meteorological hazards; and provide a platform for long-term process of understanding risks posed/ opportunities brought about by past, current, and future climate.	Bangladesh Cambodia Indonesia Lao PDR Mongolia (for the Winter Forum) Myanmar Sri Lanka Timor-Leste Vietnam		
	Transboundary Forum		Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri-Lanka		
	Forecasters Forums	A platform for weather forecasters from SAHF countries to exchange forecasts, particularly on extreme events, to better support user preparedness through technology and shared knowledge.	Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri-Lanka		

PILLAR 5: COMMUNITY OUTREACH AND FEEDBACK

RIMES Services		Services / System Description	Services Available to the Countries	Country Presences	Potential Source of funding Sources 1. Country Annual budget 2. Country Specific Donor/ Development partner supported project 3. Regional Project in which Country is/will be participating
Training for Officials/ Professionals at National and Sub-National level	Training on Early Warning and Risk Management	RIMES provides training to officials on disaster risk management, forecast based preparedness, and disaster response capabilities.	Bangladesh		
	Capacity Building training for forecasters	RIMES supports the NMHS in building capacity for using the latest technology in forecast and early warning generation, monitoring, and dissemination.	Bangladesh		
	Customization of Ocean Forecast Products	RIMES supports countries in conducting surveys and generating Digital Elevation Models (DEMs) to enhance localized forecasting and disaster preparedness.	Seychelles Thailand Timor-Leste		
	Demonstrations of climate information application	RIMES facilitates climate information application demonstration activities in pilot sites to train disaster managers, resource managers, including farmers, in the seamless use of probabilistic climate information at different timescales in planning and decision-making.			

		The institutional system established for climate information application enables receipt of feedback from end-users on usability of climate information and, based on this feedback, the improvement of climate information products and delivery system.			
	IBF Capacity Building Services	RIMES provides training and workshops to enhance stakeholder capacity on Impact-Based Forecasting (IBF), covering hazard assessments, implementation strategies, partnership-building, and effective risk communication.	Bangladesh, Cambodia Pakistan Nepal Sri Lanka		
	Forecast translation into potential impacts and risk management/ adaptation options	RIMES builds capacities of users in interpreting forecasts and projections, and in participatory analysis of likely impacts in sectors of concern and identification of risk management and adaptation options. This capacity building component is also integral in RIMES climate information application projects.	Madagascar Fiji PNG Samoa Myanmar Maldives *		
	Enhancing Local Disaster Risk Management and Climate Resilience	RIMES provides training, assessments, and plan development to enhance disaster preparedness, integrate early warning systems, and improve coordinated response strategies. RIMES also facilitates climate information application demonstration activities in pilot sites to train disaster managers, resource managers, including farmers, in the	Bangladesh Sri Lanka Nepal Pakistan		

		seamless use of probabilistic climate information at different timescales in planning and decision-making. The institutional system established for climate information application enables receipt of feedback from end-users on usability of climate information and based on this feedback, the improvement of climate information products and delivery system.			
Institutional Development	Support to Anticipatory Action framework development	RIMES provides technical support to NMHS in developing triggers and thresholds for early action and ex-ante financing mechanisms. In collaboration with the relevant stakeholders in the countries including National Disaster Management Organizations and humanitarian agencies RIMES develops early action protocols for institutions and provides technical support in testing, simulation and operationalization.	Bangladesh Cambodia Myanmar Philippines		
	Hazard Warning Dissemination Enhancement	RIMES conducts SOP assessments to improve the efficiency and speed of national hazard warning systems, ensuring compliance with international standards and alignment with national protocols.	Bangladesh Thailand		
	Forecast Dissemination System	The system supports the design, development and dissemination of multi-hazard early warning products			
Capacitating Communities	Climate Risk Management Field Schools	Climate Risk Management Field School is a multi-tier learning-by-doing capacity building program for	Bangladesh India Philippines		

		farmers, for integrating weather and climate information in crop management. The curriculum is delivered over 13 weeks, facilitated by the NMHS, Department of Agriculture, and RIMES. The school enhances understanding by farmers of weather/climate–crops–pests and diseases issues and the use of weather and climate information in improving crop management, promotes better understanding by forecast providers of farmers’ forecast application contexts and issues, and advocates for and facilitates farmer’s use of forecast information in crop planning and management.			
User Feedback	Assessing community response	RIMES conducts evaluations and assessment of early warning systems and community response to advisory services. These assessments help identify critical gaps to reach last mile communities as well as determine value for money invested in early warning and climate information services.	Bangladesh India		

REFERENCE DOCUMENT 1.

RIMES PORTFOLIO OF CLIMATE SERVICES AND EARLY WARNING INFORMATION SERVICES

RIMES Key Services are as follows:

- 1) Establishment and maintenance of core regional observing and monitoring networks: establishment of observing and monitoring stations that are of regional interest, and maintenance support as host countries require, until such cost is integrated into NMHS operational budgets
- 2) Earthquake, tsunami, and ocean services: seismic and ocean monitoring; data exchange, processing, analysis, and archiving; earthquake alerts and potential earthquake damage; regional tsunami bulletins and loss estimates; customized ocean information products; earthquake, tsunami, and coastal hazard assessments
- 3) Weather, climate, and hydrological services: downscaled weather, climate, and flood information products at different timescales; hydro-meteorological hazard assessments
- 4) Capacity building services: early warning system audits; user need assessments; vulnerability and risk assessments; development, piloting and transfer of impact forecasting tools; training of scientists and users; establishing and strengthening of early warning provider and user dialogues at national and local levels; enhancing community responses to early warning; demonstrations of forecast information application in development and disaster risk reduction plans and decisions

Portfolio of Services				
Observation & Monitoring	Weather & Climate		Sector Specific Tools	
AWS, AWLS:	3-Days Forecast; 10 Days Forecast:	NCOFs	Agriculture	Health
Myanmar, Nepal, Philippines, Bangladesh, Maldives	RIMES Domain	Myanmar, Nepal, Pakistan, Sri Lanka, Bangladesh, Cambodia, Lao-PDR, Maldives, PNG, Bhutan	SESAME	CRISH
Buoys:	Monthly & Seasonal Forecast:		Myanmar, Nepal, Bangladesh, Timor Leste, Bhutan, India, Pakistan, Sri Lanka	India, Timor Leste
Seychelles, Sri Lanka	South Asia, SEA, Africa, Middle East	Capacity Building	Hydrology:	Disaster Management:
	Climate Change Projections:	Secondment Training:	Seasonal Flow Outlook	SMART
24 X7 Operational Support	Maldives, Sri Lanka, Myanmar, Pakistan, Nepal, Bangladesh, Madagascar	Nepal, Pakistan, Cambodia, Lao-PDR, Bhutan, Bangladesh, Myanmar, Sri Lanka, Philippines, Vietnam	Bangladesh	India, Myanmar, PNG, Nepal
EQ Monitoring	Regional Forums	FARM School:	Flash Floods:	Tsunami :
Tsunami Forecasting:	Transboundary Flood Forum	India, Myanmar, Maldives, Sri Lanka, Bangladesh	Bangladesh	INSPIRE and ESCAP
Extreme Weather Forecasting:	South Asia	SAHF Knowledge Hub and Weekly Forecasters Forum:	10-days Forecast	Myanmar, Philippines, Thailand, Seychelles, Sri Lanka
RIMES Domain	RCOFs	South Asia	3-day Flood Forecast	INSTANT
Flood Forecasting:	South Asia, Southeast Asian, East Africa		Myanmar, Nepal, India, Sri Lanka, Bhutan	Bangladesh, Nepal, Pakistan, Sri Lanka
Myanmar, Nepal, Sri Lanka, Bhutan			Reservoir Management	Ocean State:
			Sri Lanka	OSAFS
				Seychelles, Maldives, Sri Lanka, Timor Leste

Figure 3. RIMES Portfolio of Services

1. IMPROVING DATA AVAILABILITY	
1.1 Enhancement of observing and monitoring systems	To enhance data availability in RIMES Member States in support of forecast modeling and product improvement activities, RIMES facilitates the enhancement of observation systems by establishing and/or upgrading observing stations. These include telemetered seismic, sea level, deep ocean, weather, water level, and agro-meteorological observing systems.
1.2 Data integration system	RIMES assists NMHSs in unifying diverse data acquisition platforms and developing a data portal for storage, exchange, dissemination, and archiving.
1.3 Regional data sharing	RIMES Member States share non-GTS data to ensure the availability of local data to improve forecast products. RIMES collects data from NMHSs, performs data quality control, distributes quality-checked data to Member States and participating agencies (e.g. the European Centre for Medium-Range Weather Forecasts (ECMWF)), uses these data to improve RIMES products and for sector-based impact assessment studies, and ensures availability of quality-checked data for WMO's data assimilation research. The Data Exchange Platform (DATAEX): a web-based tool for data analytics and visualization, developed in response to the needs of meteorological services. It is a platform for analyzing forecast data, including subset and region-specific analyses. DATAEX incorporates observational data shared by RIMES member countries. To support this, the platform features a data collection mechanism, automated quality checks (QC), and integration of in situ observation data from meteorological services in the region. It also offers access to the latest high-resolution forecast products from global/regional producing centers like ECMWF and the India Meteorological Department (IMD). DATAEX includes several engines that enable meteorological services to compute forecast and observed data for specific locations or basins instantly. With its graphics engine, users can generate regular forecast products for operational use. Furthermore, met services can utilize API services to automate data processing and graphic generation processes. DATAEX Platform is also used to undertake forecast verification and provide feedback to global/regional forecast producing centers such as ECMWF
2. EARTHQUAKE, TSUNAMI, AND OCEAN SERVICES	
2.1 Earthquake monitoring and tsunami warning	RIMES operates a 24/7 regional facility for earthquake monitoring and tsunami warning, with the following capabilities: - o Automatic seismic data acquisition system: Antelope and SeisComP are used as redundant systems - o Sea level data acquisition system: Global Telecommunication System (GTS) link through the Maldives and customized Tide Tool run as redundant systems - o Database of pre-computed tsunami simulations - o Near real-time tsunami forecasting system: a web-based portal for regional estimation of coastal tsunami impacts using earthquake and tsunami information (named PRECISE). The system retrieves tsunamigenic earthquake information within RIMES area of responsibility from the seismic data acquisition system; calculates slip values of selected unit sources based on

	earthquake information within RIMES area of responsibility from the seismic data acquisition system; calculates slip values of selected unit sources based on earthquake magnitude; retrieves sea level data from the sea level data acquisition system; systematically combines tsunami simulation results from a pre-computed tsunami simulation database, for all unit sources that contribute to the earthquake using a superposition method; refines unit source parameters based on sea level data using inverse analysis technique; computes inundation using bathymetric and topographic data, in three nested regions; visualizes tsunami amplitude, arrival time, and coastal inundation in Google Earth; and generates tsunami bulletin - o Decision support system for dissemination of alerts, warnings, and bulletins according to formats prescribed by UNESCO/IOC for the Indian Ocean Tsunami Warning and Mitigation System (IOTWS) - o Dissemination systems: SMS, email, fax, website - o Confirmation by phone of receipt of information by the National Tsunami Warning Center (NTWC)
2.2 Tool development/ customization	RIMES developed the following tools, which can be customized according to each country's specific requirements: • <i>Ocean state forecasting and advisory system</i>: a web-based system for generation of advisories based on location-specific ocean state forecast information from INCOIS' Indian Ocean Forecast System (INDOFOS). • <i>ShakeCast</i>: An online tool for rapid earthquake risk assessment, estimating risks to population and critical facilities using real-/ near-real-time data from an earthquake event. • <i>INSPIRE</i>: online tool for tsunami propagation, inundation simulation, and risk assessment. RIMES' internet-based simulation platform for tsunami inundation and risk evaluation, named INSPIRE, is a web portal that provides modules for: identifying tsunami sources, simulating tsunami propagation and inundation, integrating exposure data, and performing tsunami loss estimation. • <i>Low-cost methodologies for near-shore bathymetric, topographic, and exposure surveys</i>. These survey methodologies generate high-accuracy near-shore bathymetric and topographic datasets for coastal inundation analysis, and an exposure dataset for vulnerability assessment. The bathymetric survey involves a sonar survey using an ordinary single-beam fishing sonar and an optimized survey route interval, as well as tidal measurement using a temporary portable tide gauge for correcting raw sonar depth readings. The topographic survey involves a post-processed kinematic GPS survey for photogrammetry, and a real-time kinematic (RTK) GPS survey for collecting elevation data along the road network. Remote sensing data is used in areas that are inaccessible and where the GPS signal is weak. Shoreline is delineated to define the connection between land and sea. Rivers that drain to the sea are surveyed through sonar, pole, or walking RTK GPS survey. Windshield survey, using digital video recorders with built-in GPS mounted on a slow-moving vehicle, collects data on location, materials, construction type, number of

	of floors, and usage of buildings and critical facilities. More details on the tools developed are provided in Appendix 2.
2.3 Earthquake, tsunami, and coastal hazard assessments	RIMES undertakes hazard assessments to characterize hazards that at-risk communities face, as inputs to resilience planning. Earthquake, tsunami, and storm surge hazard assessments use probabilistic methodologies that involve modeling, while sea level rise hazard assessments use trend analysis from long-period historical observation data.
2.4 Capacity Building	RIMES Member States participate in 24/7 earthquake monitoring and tsunami warning operations through the secondment of technical personnel, who receive on-the-job training in the process. Those who opt to stay longer than the 6-month operational training are involved in research, guided by RIMES scientists.
3. WEATHER, CLIMATE AND HYDROLOGICAL SERVICES	
3.1 High-resolution weather (up to 10 days) and extreme weather information	RIMES' Weather Research Forecasting (WRF) model, originally developed at the U.S. National Center for Atmospheric Research (NCAR), is customized over the African and Asian regions for a horizontal grid spacing of 9x9 km, with 5-minute topography as one of the surface boundary conditions. The model uses the US National Center for Environmental Prediction's Global Forecast System (NCEP GFS) products as initial and boundary conditions for generating daily weather information, with up to 84 hours lead time. Model configuration is as follows: • Model domain: 19.43oE – 150.61oE 18.04oS – 50.87oN • Horizontal resolution: 9km x 9km • Initial conditions: NCEP GFS analyses and forecast products • Integration period: 84 hours starting 12 UTC daily • Post-processed outputs: Wind, geopotential height, temperature at standard levels, and rainfall RIMES WRF forecast products are provided daily, on demand, to NMHSs of 15 countries: Afghanistan, Bangladesh, Bhutan, Cambodia, Comoros, Lao PDR, Maldives, Myanmar, Nepal, Pakistan, Papua New Guinea, Philippines, Seychelles, Sri Lanka, and Timor-Leste. Whenever severe weather occurs over the region, RIMES integrates the model with higher grid resolution, and severe weather information is provided to countries that may be potentially affected. Model outputs are then used as inputs to the appropriate storm surge/ hydrological model for storm surge/ flood prediction.
3.2 Monthly and seasonal forecast information.	RIMES assists countries, on demand, in the analysis of the climate outlook for the season. Forecast models from various global climate centers are analyzed against historical observations to select models that are consistent with local climatology. The seasonal climate outlook is generated using products from this ensemble prediction system, which are then analyzed to identify deviations from normal values.
3.3 Downscaled climate projections	RIMES identifies global climate models that are consistent with observed climate data and trends over the region. Dynamical and statistical downscaling techniques are then used to generate

	climate scenarios for selected time slices for the country. Evaluation is then undertaken against the baseline climatology.
3.4 Climate Data Access and Analysis System (CDAAS)	CDAAS is a web-based system for access to and analysis of climate data and scenario products, for the generation of downscaled projections for any area of interest within the RIMES domain. The system contains datasets from 8 Global Climate Models (CMIP5 GCMs), 6 models from NASA Earth Exchange (NEX), and 6 Regional Climate Models (RCMs) of the Coordinated Downscaling Experiment (CORDEX) South Asia. Each model data spans the period 1980-2005, representing the baseline period, and future projections for the period until 2100. CDAAS also includes 2 future emission scenarios – RCP 4.5 (moderate) and RCP 8.5 (high). These datasets enable telescopic downscaling of climate baseline and projections, from coarse resolution GCMs (~180km) to downscaled information of up to ~25km, from multiple climate models, enabling the development of robust climate change projections with uncertainty levels. The climate data analysis engine is capable of a variety of climatological analysis, including analysis of extremes.
3.5 Extended Range Prediction (ERP)	It is developed to support the services that are met and to give them access to extended-range climate outlooks. The model used global/regional products from IMD's CFSv2 coupled model (Atmospheric and Ocean model) for the provision of extended range forecast or outlooks for rainfall, and temperature for a 4-week lead time. The tool also integrates sub-seasonal to seasonal forecast indices for sector users' application, such as agriculture, public health, and water resources. The tool provides access to operational forecasters to regularly upload observation data for forecast performance analysis on a weekly basis, including the forecast, the climate normal, and the realized weather at a sub-national level.
3.6 Flood Impact Forecasting	It is developed to support efficient planning of the water resources and real-time operation and management for river monitoring and management of water resources infrastructure. The tool assists the water management departments in handling flood situations more efficiently and ensures preparedness measures before each flood season. It also assists in reliable flood hazard, exposure, and vulnerability assessments. Efficient flood and river management can be achieved through data-driven decision-making. The tool integrates data like road network, land use, and population data to estimate the impact of different intensities of flood scenarios.
3.7 Tool Development	RIMES developed tools that make use of forecast products of different lead times for assessment of potential impacts and generation of guidance/advisories. Forecast model outputs used are RIMES WRF model outputs of 3 days lead time, NCEP model outputs of 7 days lead time, and ECMWF model outputs of 10 and 15 days lead times, Japan Meteorological Agency Grid Point Values (JMA GPV) model outputs of 30 days lead time, and ECMWF and RIMES ensemble seasonal forecast model outputs of 6 months lead time. Tool customization integrates forecasts available from the NMHS and user requirements, determined through need assessments. Relevant national agencies co-develop country-specific tools. Tools are transferred and run on an experimental basis before integration

	into these agencies' operations. • The Storm Surge Inundation Forecasting and Warning System is a web-based system for evaluating inundation risks from the storm surge potential of predicted cyclones. The system generates and disseminates surge and inundation risk maps and accompanying advisories, along with forecasts of cyclone track, intensity, and rainfall. • The Basin-Based Flood Forecasting and Warning System is a web-based system for the generation of basin discharge and river level forecasts based on 3-day and 10-day weather forecasts, analysis and mapping of flood risks, and the generation and issuance of appropriate advisories. The system ingests real-time observation data for water level monitoring. The system has modules for the correction of biases in rainfall and discharge forecasts. • Decision support system for reservoir operation and management is a web-based system for the generation of reservoir inflow forecasts based on 3-day and 10-day weather forecasts and seasonal climate outlook, using a rainfall-runoff hydrological model. A reservoir operation simulation model is integrated into the system for analysis of reservoir operation strategies. • Specialized Expert System for Agro-Meteorological Early Warning (SESAME) is a web-based Decision Support System for generating and disseminating crop management advisories for specific crops at particular growth stages, based on weather and climate information at different timescales. • Livestock Advisory Service (LAS) is a decision support system (DSS) developed to support climate-resilient planning and management exclusively for the livestock sector and is used by relevant sectoral departments for livestock extension service delivery. • Climate Risk Information System for Public Health (CRISH) is an advanced decision support system designed to enhance public health management by utilizing a deep learning approach that integrates location-specific climatology of weather parameters with historical health data. • Multi-Hazard Potential Impact Assessment and Emergency Response Tracking (SMART) is a web-based system for assessing potential impacts of a hazard using weather forecast information and for evaluating, generating, and disseminating impact management options. The system also acts as a data management system for managing and processing weather, deployment, and management.
	• SATARK (System for Assessing, Tracking, and Alerting Disaster Risk Information based on Dynamic Risk Knowledge) is an advanced web-based decision support system designed for the management of multiple hazards. It aims to help improve disaster preparedness and response through dynamic risk assessment, early warning systems, value-added forecasting, and impact-based forecasts for a number of hazards.

	• Integrated Forecast Dissemination (INSTANT) is a web-based platform developed for sharing forecast products, risk, and resource-related information in an intuitive manner through iconography and customizable templates. The platform is used by met services to communicate impact-based forecasts by integrating real-time data with exposure and vulnerability information from collaborating departments. The system is capable of automatically disseminating alerts for major extreme events to its subscribers. It is widely used by disaster management organizations, I/NGOs, and UN agencies for anticipatory actions and disaster preparedness in implementing member countries – Bangladesh, Nepal, Pakistan, and Sri Lanka. More information on the tools developed are provided in Appendix 2
3.8 Hydro-meteorological hazard assessments	RIMES undertakes assessments of hydro-meteorological hazards to inform resilience planning. Hazard assessments for strong winds and tropical cyclones are based on thresholds; flood hazard assessment involves hydrological and hydraulic modeling; and drought hazard assessment involves calculations of standard precipitation and drought hazard indices.
3.9 Capacity Building	On demand from Member States, RIMES builds capacities of scientists, forecasters, and technical specialists through in-country training and on-the-job training at RIMES in the areas of climate modeling, numerical weather prediction, weather forecast-based flood forecasting, Linux server administration and management, etc.
3.10 Support for Anticipatory Action framework development	RIMES provides technical support to NMHS in developing triggers and thresholds for early action and ex-ante financing mechanisms. In collaboration with the relevant stakeholders in the countries, including National Disaster Management Organizations and humanitarian agencies, RIMES develops early action protocols for institutions and provides technical support in testing, simulation, and operationalization.
4. CAPACITY BUILDING OF USERS	
4.1 Forecast Provider-User Forums	RIMES assists countries in establishing Monsoon Forums, a national platform for forecast provider-user dialogue, which aim to: (i) ensure that forecasts, including their uncertainties and limitations, are communicated to and understood by users; (ii) encourage forecast application for mitigating risks in various climate-sensitive sectors, including, but not limited to agriculture, water resources, disaster management, and health; (iii) receive user feedback for improving usability of forecast products; (iv) provide a platform for inter-agency coordination of policies, sectoral plans, and programs for dealing with potential impacts of hydro-meteorological hazards; (v) and provide a platform for long-term process of understanding risks posed/opportunities brought about by past, current, and future climate.
4.2 Forecast translation into potential impacts and risk management/ adaptation options	RIMES builds users' capacities in interpreting forecasts and projections, participatory analysis of likely impacts in sectors of concern, and identification of risk management and adaptation options. This capacity-building component is also integral in RIMES climate information application projects.

4.3 Climate Risk Management Field Schools	The Climate Risk Management Field School is a multi-tiered, learning-by-doing capacity-building program for agricultural extension officials and farmers, aimed at integrating weather and climate information into crop management. The curriculum spans 13 weeks and is facilitated by the NMHS, the Department of Agriculture, and RIMES. The CRM Field School enhances the understanding of weather, climate, crop, pest, and disease issues among extension officials and farmers and promotes the use of weather and climate information to improve crop management. It also fosters better comprehension among forecast providers regarding farmers' contexts and challenges in applying forecasts and advocates for farmers' usage of forecast information in crop planning and management.
4.4 Demonstrations of climate information applications	RIMES facilitates climate information application demonstration activities in pilot sites to train disaster managers and resource managers, including farmers, in the seamless use of probabilistic climate information at different timescales in planning and decision-making. The institutional system established for climate information application enables the receipt of feedback from end-users on the usability of climate information and, based on this feedback, the improvement of climate information products and the delivery system.
4.5 ESCAPE: online tool to support evacuation planning	RIMES' evaluation system for computing accessibility and planning evaluation, named ESCAPE, is a web-based system for mapping the shortest and fastest evacuation route toward safe shelters, with due consideration of topographic conditions, land use, location of critical facilities, population density, age, and gender. The system can also evaluate shelter capacity against the expected number of evacuees.

REFERENCE DOCUMENT 2.

RIMES-DEVELOPED DECISION SUPPORT SYSTEMS

RIMES DSS	DESCRIPTION
Shakemap Broadcast (ShakeCast)	A tool developed by the U.S. Geological Survey and customized by RIMES for estimating risks to population and critical facilities using real-/ near real-time data from an earthquake event. Potential damage information is sent to registered users by SMS, fax, and email. Bulletins are updated based on improved earthquake parameters for the event. ShakeCast customization uses exposure data at smallest administrative unit (e.g. village level population data and detailed building inventory) and appropriate building vulnerability functions.
Portal for Regional Estimation of Coastal tsunami Impacts using Sea-level and Earthquake information (PRECISE)	A tsunami forecasting tool developed to determine tsunami arrival time, directivity, amplitudes and inundation. It combines preliminary earthquake information: magnitude and epicenter location, with a pre-computed tsunami database to generate a comprehensive forecast with points along coasts that would be potentially affected. The system uses sea-level information obtained from DART buoys and tidal gauges to update and validate forecasts. A unit-source database has been developed for the Sunda (Western Philippines) and Makran (Central Asia Region) subduction zones as they can generate destructive tsunamis in the Indian Ocean and the South China Sea. Since DART buoys and tidal gauges have been installed and upgraded after the 2004 Indian Ocean Tsunami, near real-time data from the sea-level sensors can be used to revise fault parameters of an earthquake by using inverse analysis. The inundation forecast is performed using the nonlinear TSUNAMI model at some key coastal sites. Results from simulation are compiled in a bulletin format to distribute to countries.
Internet-based Simulation Platform for Inundation and Risk Evaluation (INSPIRE) <u>Countries:</u> Myanmar, Philippines, Sri Lanka	Web portal with modules for identifying tsunami sources, simulating tsunami propagation and inundation, and risk assessment - integrating exposure data, and performing tsunami loss estimation. It has analysis modules that handle multi-dimensional vulnerability data and different levels of data accuracy, allowing users to undertake preliminary tsunami risk assessment using available data, with progressive improvement in assessment results as more detailed and accurate datasets are used. INSPIRE outputs include tsunami inundation maps, showing maximum inundation depths, maximum flow velocities, and estimated tsunami arrival times; and tsunami loss estimates in terms of probability of casualty, probabilities of building collapse/ severe damage for different building types, and number of buildings that could be inundated at an inundation depth range for buildings of different construction and occupancy types.
Evaluation System for Computing Accessibility and Planning Evacuation (ESCAPE) <u>Countries:</u> Myanmar, Philippines, Sri Lanka	Web portal that supports evacuation planning. It maps and advises on the fastest evacuation routes to shelters, considering topographic condition, land use, location of critical facilities, and population density, age, and gender. It also determines evacuation basins and shelter capacity.

Ocean State Forecasting and Advisory System (OSFAS) <u>Countries:</u> Maldives, Seychelles, Sri Lanka, Timor-Leste	Web-based tool for providing customized forecasts and real-/near real-time observation data on local ocean/marine conditions, including warning bulletins based on 3-day marine forecasts and a user-friendly feedback system for validating forecast information. In addition, the system has capability to track wave rider buoy location and has an alert messaging service in case of buoy drift. Moreover, the system can provide information from INCOIS' Marine Fishery Advisory (derived from satellite images and Potential Fishing Zone (PFZ) advisories) and Coral Reef Mapping and Reef Health Monitoring (derived from satellite images and Coral Bleaching Alert System).
Climate Risk Information System for Public Health (CRISH) <u>Countries:</u> India, Timor-Leste	An advanced decision support system designed to enhance public health management by utilizing a deep learning approach that integrates location-specific climatology of weather parameters with historical health data. This innovative system combines multi-timescale weather forecasts, climate outlooks, and historical data to predict and map potential outbreaks of climate-sensitive diseases. The system integrates real-time disease surveillance data shared by healthcare providers to support informed decision-making. Currently, this public health advisory system is based on 3-day and 10-day forecasts of extreme weather conditions for diseases that have high correlation with weather patterns, such as diarrhea, malaria, and dengue. This expert system analyzes and maps localities that have likelihood of disease occurrence, generates and disseminates weather forecast products with accompanying health advisories for each disease, displays real-time disease surveillance data, and receives feedback from users. Additionally, CRISH offers graphical analysis tools to visualize disease trends across various demographics, includes comprehensive details on healthcare facilities for resource allocation, features a medical transport network with ambulance contact information to facilitate swift emergency responses, and provides public health education resources.
Specialized Expert System for Agro-Meteorological Early Warning (SESAME) <u>Countries:</u> Bangladesh, Bhutan, Cambodia, Fiji, India, Papua New Guinea, Sri Lanka, Pakistan, Myanmar, Timor-Leste	Web portal for generating and disseminating crop management advisories for specific crops at particular growth stage, based on weather and climate information at four different timescales, which are: • 3-day high resolution weather forecast to inform daily decision-making • 10-day weather forecast (separated into two pentads) for planning week-ahead activities • Monthly outlook for planning activities that require longer lead time • 3-monthly outlook for long-term seasonal planning SESAME maps crop sensitivity to a particular weather condition, processes how the predicted weather will influence crop growth, and generates crop advisories using crop-specific decision tree and machine-learning algorithm. The system has capabilities for disseminating bulletins via email, SMS, fax, social media (Facebook), and mobile app, as well as capability for receiving user feedback. SESAME generates: • Real-/near real-time or most recent observation data and weather information for the past decade, month, and season to

	aid understanding of current and recent historical weather condition; • daily weather forecast, daily update of the pentads (five-day spells), and monthly and 3-monthly outlooks; information on the normal for the pentad, decade, monthly, and 3-monthly climate; • crop management advisories, accompanying the forecasts and outlooks. Another feature of the system comprises notifications about pest and disease outbreaks, warnings regarding severe weather events such as heat waves, cold waves, heavy rainfall, strong winds, and stage-wise crop water requirements. The system has capabilities for disseminating bulletins via email, SMS, social media, and a mobile app, as well as the capability for receiving user feedback.
Flood Cautioning and Alert System (FloCAST) <u>Countries:</u> Bangladesh, Bhutan, Myanmar, Nepal, Philippines, Sri Lanka	Web-based system for generation of basin discharge and river level forecasts based on 3-day and 10-day weather forecasts and real-time water level observations, analysis and mapping of flood risks, and generation and issuance of appropriate advisories. The system has modules for correction of biases in rainfall and discharge forecasts, and ingests real-time observation data for water level monitoring.
System for Assessing, Tracking, and Alerting Disaster Risk Information based on Dynamic Risk Knowledge (SATARK) and System for Multi-Hazard Potential Impact Assessment and Emergency Response Tracking (SMART) <u>Countries:</u> India Timor-Leste	Web GIS-based system that utilizes weather, geophysical, and oceanic forecast products to assess potential impacts, disseminate impact management options, and evaluate risk reduction strategies. The mobile applications communicate the risk, issues alerts, and receives feedback on responses to these alerts. SATARK is operational and integrated into operations of Odisha State Disaster Management Authority (OSDMA) in India. It is designed for the management of multiple hazards. It helps improve disaster preparedness and response through dynamic risk assessment, early warning systems, value-added forecasting, and impact-based forecasts for a number of hazards. Employs both current and past data to evaluate potential impacts of hazards on communities, infrastructure, and livelihoods. Facilitates anticipatory planning and response by delivering tailored risk insights to various stakeholders. Contributes to enhanced preparedness, faster responses, minimized losses, localized understanding, and strategic resource distribution and evacuation strategies informed by anticipated risk levels. SMART, operational in Tamil Nadu, India as TNSMART, is for assessing potential impacts of a hazard using weather forecast information and for evaluating, generating, and disseminating impact management options. The system also acts as a data management system for managing and processing weather, disaster risk, and emergency response resources data for resource allocation, rapid deployment, and management. The system generates and disseminates weather forecasts, forecast-based risk maps, and accompanying advisories. The system can visualize emergency response resource locations and quantities and can also display updates from the ground that are entered by registered users, thus allowing disaster managers to track and manage ongoing emergency response.

Climate Data Access and Analysis System (CDAAS)	CDAAS is a user-friendly web-based portal to access and analyze different global climate models, gridded observation datasets, and downscaled regional climate model products. It is designed to serve both the lay end-user to easily generate powerful visualizations as well as experts for detailed analysis. Users with access to the system can select the region of interest and get the respective data sets in various formats for further analysis. The tool handles data from three different sources and is categorized primarily based on the horizontal grid resolution of the models. Which includes CMIP5 Global Climate Models (GCMs), Coordinated Regional downscaling experiments (CORDEX), and NEX Nasa datasets.
Forecast Customization (FOCUS)	FOCUS is a web-based application developed by RIMES, with support from the UK MET under the ARCCC, intending to support the NHMSs in the region to access and generate customized seasonal forecasts using the inbuilt Multi-Model Ensemble (MME) methods. The tool also supports the validation and verification of the estimates.
Regional Resilience Data and Analytics Service (RDAS) <u>Country: Afghanistan</u>	RDAS is a cloud-based, open-access platform for acquiring, storing, managing, processing, analyzing, visualizing, reporting, and combining climate and sectoral data with analytics capacities to determine climate risks and inform decisions, resource and risk management, policy, planning and investment decisions in the region. It is an artificial intelligence-/machine learning-enabled data and analytics platform that leverages various available data and analytical services relevant to climate-smart development in the South Asia region. Using standard web services, it provides science-based high-quality climate information, as well as sector information, to guide policy- and decision-making for climate resilience in the region. It integrates different data sources, including socio-economic parameters, to review climate vulnerability across timescales and support planning and investment-related decision-making. RDAS is designed as a dynamic platform, able to respond to evolving data needs from the sectors, and generate, curate, and host new climate and thematic data. RDAS ingrates data from the World Bank, FAO, UNESCAP, NEX NASA, ECMWF, MODIS, LANDSAT, EM-DAT, GDACS, UNISDR, INFORM, etc., and uses the ETL, a method to efficiently transfer raw data from the source (Extract), convert it into a suitable form for storage (Transform), and insert it into the data repository (Load) and analytics subsystem, responsible for Online Analytical Processing (OLAP) queries, computation, machine learning, generating reports, and visualization on-demand from the users. RDAS has a comprehensive data catalog that provides details of all the data used in the system.
Data Exchange Platform (DataEx) for Climatic/ Hydrometeorological Data Sharing	DataEx is a dynamic data exchange platform developed by RIMES in cooperation with ECMWF and in collaboration with NMHSs of the member states. It enables secure exchange of country specific meteorological data, both archived station dataset with metadata and real-time data, otherwise not available in the WMO network (GTS). The data sharing mechanism helps ECMWF to further improve forecast verification and validation by assimilation into existing

	models. As a result, countries have access to high resolution forecast products for operational use.
Climate Data Access and Analysis System (CDAAS)	CDAAS is a user-friendly web-based portal to access and analyze different global climate models, gridded observation datasets, and downscaled regional climate model products. It is designed to serve both the lay end-user to easily generate powerful visualizations as well as experts for detailed analysis. Users with access to the system can select the region of interest and get the respective data sets in various formats for further analysis. The tool handles data from three different sources and is categorized primarily based on the horizontal grid resolution of the models. Which includes CMIP5 Global Climate Models (GCMs), Coordinated Regional downscaling experiments (CORDEX), and NEX Nasa datasets.
Storm Surge Inundation Forecasting and Warning System	A web-based system for evaluating inundation risks from the storm surge potential of predicted cyclones. The system generates and disseminates surge and inundation risk maps and accompanying advisories, along with forecasts of cyclone track, intensity, and rainfall.
DSSs FOR AGRICULTURE SECTOR	
Bangladesh Agro-Meteorological Information Service (BAMIS)	It is a dynamic web portal developed under Agro-Meteorological Information Systems Development Project (Component C: BWCSR), DAE with a view to disseminate agro-meteorological services and other related information to the different users especially to the farmers in Bangladesh. Meteorological data from Bangladesh Meteorological Department and hydrological data from Bangladesh Water Development Board will be accumulated in BAMIS portal. After being translated and validated by the DAE Agromet Technical Committee the information will be disseminated at present to the 30000 lead farmers. It will be linked with other relevant stakeholders including DAE officials. Agro-meteorological services and other related information provided in BAMIS include: • Weather and Climate information across Bangladesh • Updated 64 districts agromet advisories twice in a week and one national agromet advisory once in a week. • Agromet information in respect of crop, weather sensitivities on crops, pests and diseases information and its linkages with weather along with control measures, Crop Weather Calendars etc. • Development of Agro-Meteorological products including satellite products to help different users to make tactical & strategic decisions • Dissemination of agro-meteorological and hydrological information, forecasts and agromet advisories through different modes to the farmers through Department of Agricultural Extension and Agriculture Information Service. • Information on extreme events • Special Agromet Advisory Services for livestock, poultry and fishery • Feedback from farmers • Others

National Livestock Advisory System (NLAS) <u>Country:</u> Bangladesh	A decision support system (DSS) developed to support climate-resilient planning and management exclusively for the livestock sector and is used by relevant sectoral departments for livestock extension service delivery. It allows real-time monitoring of extreme weather events with the potential of affecting livestock resources, integrates multi-timescale multi-hazard risk information, automatically generates advisory templates, and disseminates to various user groups. The DSS assists in the tactical management of livestock shelters, fodder production, disease control, vaccination, etc. On the other hand, it provides strategic guidance on climate adaptation based on projected climate risk indicators for livestock. It provides the following products: • Hazard alerts (heavy rainfall, heatwave, cold wave) at sub-district level • Temperature-Humidity Index (THI) alerts, initially for cattle (in particular, the Australian breed which is 30% of cattle population) at district level • Weather forecast at sub-district level • Population (statistics and contribution to the GDP) • Monthly and seasonal advisory, based on consultations with the Department of Livestock Services Technical Working Group • District-wise bulletins for heatwave, flood, and flash flood in Bangla and English languages • Analytics: disease analytics and station-wise climate analytics
Bihar Integrated Knowledge System for Climate Resilient Agricultural (BICAS)	A web-based component connected to IMD-Agro-DSS that can be used by State Agricultural University scientists, KVKs and extension workers for generating and disseminating crop advisories for specific crops at particular growth stages at the pilot locations of the CRA project.
Agromet Decision Support System (ADSS) for Bhutan	Provide agromet advisories to 11 gewogs across five districts: Paro, Sarpang, Punakha, Wangdue Phodrang, and Mongar. It is envisaged to continuously provide the targeted farming communities with real-time weather conditions, weather forecasts, and customized crop advisories utilizing localized climate thresholds, crop status, and pest and disease occurrences.
Nepal's Agriculture Management Information System (NAMIS)	In collaboration with the Ministry of Agriculture and Livestock Development (MOALD), RIMES is upgrading Nepal's Agriculture Management Information System (NAMIS). Stakeholder consultations to ascertain user needs and requirements were undertaken in 2022.
DSS for the Ministry of Agriculture and Livestock Development (MoALD) <u>Country:</u> Nepal	Includes a module for district-wise crop advisory based on weather conditions, e.g., rainfall and temperature, crop growth stages, and seasons. MoALD agreed to develop the DSS independently from, and ready for integration into, the NAMIS Portal, if and when access is possible. The DSS prototype for MoALD can be accessed at https://moald.vercel.app/.

DSSs FOR DISASTER RISK MANAGEMENT	
Risk Anticipation for Preparedness and Informed Decision-Making Portal (RAPID) <u>Country:</u> Bangladesh	It is an integrated web platform for linking impact-based forecasts with early actions. The initial framework and design of the portal was drafted and presented during a consultation workshop on July 2023 with DDM. It is designed to visualize information about impact-based forecasting, inundation maps, vulnerability maps, and the FBA matrix to enable informed decision-making and timely interventions. Recent enhancements in the system include: • Incorporation of E-CRA, local level bulletins, latest voice message bulletins, etc. • Addition of an FbA Matrix calculator for accelerating the decision-making process prior to an anticipated flood event. Using this dynamic calculator, location-specific early actions can be calculated against different forecast scenarios.
DSS for Multi-Hazard Early Warning (SATARK customized for NEPAL)	This DSS was designed based on NDRRMA requirements and has been integrated with forecasts for lightning, flash flood, and forest fire. Ongoing enhancements on the NDRRMA DSS involve: i) development of a flash flood prediction model based on rainfall threshold for a particular district (using daily forecasts and eventually, hourly forecasts based on the availability of data), ii) data integration into the DSS, and iii) database assessment of NDRRMA's BIPAD Portal. The NDRRMA DSS can be accessed through http://np-satark-test.rimes.int/
Integrated Forecast Dissemination Portal (INSTANT) <u>Countries:</u> Bangladesh, Nepal, Sri Lanka	Provides local-level weather forecasts and alerts on extreme events (such as extreme rainfall and temperature, and lightning events). The tool was also designed to incorporate an electronic climate risk assessment (e-CRA) module to provide risk information (hazard, exposure, vulnerability and capacity), initially in the targeted pilot locations of Melamchi and Paanch Pokhari Municipalities in Nepal, to support local government authorities in making risk-informed decisions related to disaster risk reduction and management. The customization of the INSTANT portal is being implemented under the "Strengthening Last Mile Communication in South Asia Project" supported by the United States Agency for International Development (USAID) through the University Corporation for Atmospheric Research (UCAR).
DSSs FOR TRANSPORT SECTOR	
National Vehicular and Transport Resilience Gateway (NAVIGATE) <u>Country:</u> Nepal	Developed for Nepal's Department of Roads under the World Bank CARE project. It was initiated to provide real-time and forecasted extreme weather conditions and scenario-based decision-making using climate change projection datasets. Recent developments in the DSS include: (i) road safety alerts for heavy rainfall (threshold generation), flood, fog, smog; (ii) user authentication module; (iii) uploading/updating functions for road closure, bridge closure, CRUD function for road and bridge information; (iv) uploading/updating/integration of DHM forecast data and observation data; (v) segmentation of the strategic road network (SRN) datasets, road-wise/highway-wise. The DoR system can be accessed through https://np-dor-test.rimes.int

DSSs FOR PLANNING SECTOR

Climate-Informed Planning and Development (CLIM-PLANNed) DSS for Pakistan

Developed to aid Pakistan's Ministry of Planning, Development and Special Initiatives (MOPDSI) in climate-informed project appraisal. Its features include:

- Visualization of the different components of Product 1: Impact of Extreme Climate Events, including Annual Population Affected/Exposed (Map & Chart with actual data), Annual Gender Disaggregation (Chart with actual data), Annual Urban vs Rural Disaggregation (Chart with actual data), Annual Household Risk Profile (Chart), Infrastructure Risk Profile (Chart and Map), Flood Simulation, GDP Impact and Loss (Chart and Map);
- Map visualization of the different components of Product 2: Long-term Crop Suitability, including Crop Area, Recommended Crops, Urban/Rural Areas, Level of Confidence, Climate Impact on Crop Production, Projections of Crop Production, Crop Production for Current and Future Years, and Consumption Outlook;
- Integration of district-wise and year-wise filters for Products 1 and 2;
- Models for flood, GDP Loss, and crop suitability; and Data uploading/ingestion feature through Django-admin for crop production, flood, and population data.

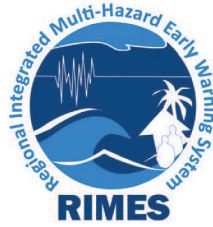
DSSs FOR WATER RESOURCE SECTOR

Basin-Based Flood Forecasting and Warning System

A web-based system for the generation of basin discharge and river level forecasts based on 3-day and 10-day weather forecasts, analysis and mapping of flood risks, and the generation and issuance of appropriate advisories. The system ingests real-time observation data for water level monitoring. The system has modules for the correction of biases in rainfall and discharge forecasts.

Decision support system for reservoir operation and management

A web-based system for the generation of reservoir inflow forecasts based on 3-day and 10-day weather forecasts and seasonal climate outlook, using a rainfall-runoff hydrological model. A reservoir operation simulation model is integrated into the system for analysis of reservoir operation strategies.



WMO - RIMES

**JOINT STRATEGY
& ACTION PLAN**

2022



MEMORANDUM OF UNDERSTANDING

between

the World Meteorological Organization (WMO)

and

**the Regional Integrated Multi-Hazard Early
Warning System (RIMES)**

concerning
cooperation on capacity development for disaster risk reduction,
climate action and sustainable development

2022

The World Meteorological Organization (hereinafter referred to as 'WMO') and the Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (hereinafter referred to as 'RIMES') hereinafter referred to as 'Parties';

CONSIDERING the provisions of the Convention of WMO, whereby WMO was created: (a) to facilitate worldwide cooperation in the establishment of networks of stations for the making of meteorological observations as well as hydrological and other geophysical observations related to meteorology, and to promote the establishment and maintenance of centres charged with the provision of meteorological and related services; (b) to promote the establishment and maintenance of systems for the rapid exchange of meteorological and related information; (c) to promote standardization of meteorological and related observations and to ensure the uniform publication of observations and statistics; (d) to further the application of meteorology to aviation, shipping, water problems, agriculture and other human activities; (e) to promote activities in operational hydrology and to further close cooperation between Meteorological and Hydrological Services; and (f) to encourage research and training in meteorology and, as appropriate, in related fields, and to assist in coordinating the international aspects of such research and training;

CONSIDERING FURTHER the role and responsibilities of RIMES, an international, intergovernmental, and non-profit-making entity established on 30 April 2009 under the Agreement on the Cooperation on Regional Integrated Multi-Hazard Early Warning System for Afro-Asian Region with the aim of providing regional tsunami watch and advisory services, and building capacity of its Member Countries for early warning of tsunami and other natural hazards through: (a) facilitations of establishment and maintenance of core regional observation and monitoring networks and ensuring data availability for early warning purposes; (b) the provision of regional tsunami watches within the framework of the United Nations Educational, Scientific, and Cultural Organization's Intergovernmental Oceanographic Commission (UNESCO/IOC); (c) the provision of research and development support to National Meteorological and Hydrological Services (NMHSs) for providing localized hydro-meteorological risk information within the framework of WMO; (d) enhancement of national systems' capacities to respond to early warning information of different lead times at national, sub-national, local, and at-risk community levels within each national early warning framework; and (e) through the provision of portfolio of options for Member States to avail from/contribute to any specific objective(s);

RECOGNIZING the vital importance of the mission of NMHSs in observing and understanding weather, water and climate and in providing meteorological, hydrological and related services in support of relevant national needs which should include the following areas: (a) Protection of life and property; (b) Safeguarding the environment; (c) Contributing to sustainable and socio-economic development; (d) Promoting long-term observation and collection of meteorological, hydrological and climatological data, including related environmental data; (e) Promotion of endogenous capacity development; (f) Meeting international agendas and commitments; and (g) Contributing to international cooperation;

ACKNOWLEDGING the complementary roles and responsibilities of WMO and RIMES and the urgent need to reaffirm and update the Memorandum of Understanding (MoU) between WMO and RIMES signed on 3 November 2010 to reflect enhanced cooperation and joint initiatives in the last decade and in response to Members' demand to expand and deepen areas of cooperation;

RECOGNIZING:

- a) the centrality of NMHSs and their capacity development needs, in particular Least Developed Countries and Small Island Developing States, in relation to providing weather, water and climate services as well as to supporting decision-making processes of sensitive sectors and stakeholders;

- b) the important role of NMHSs in the areas of disaster risk reduction, climate action and enhancement of resilience of communities, societies and nations, which contribute to socio-economic value and sustainable development; and
- c) the 2030 Agenda for Sustainable Development, the Paris Agreement, and the Sendai Framework for Disaster Risk Reduction and the increasing threats of extreme weather resulting from climate change, require action for resilience, mitigation and adaptation and pose increasing demand for actionable, accessible and authoritative information and services from NMHSs.

ACKNOWLEDGING the call of Members to strengthen the cooperation between WMO and RIMES to enhance the benefits from such cooperation;

AGREE to cooperate as follows:

Article 1 Objective

The Parties shall, in accordance with their prevailing laws and regulations and on the basis of mutual benefit, establish collaborative linkages in respect of preparedness, mitigation and early warning for specific Members relevant to both WMO and RIMES.

Article 2 Areas and Activities of Cooperation

The areas of cooperation under this MoU focus on the enhancement of the capacity of NMHSs and partner institutions to deliver meteorological and hydrological information and services and early warning products in support of disaster risk reduction, climate action and sustainable development.

The activities of cooperation under this MoU include, among others:

the development of a joint strategy and action plan, and the mobilization of resources for joint projects to enhance the capacity of NMHSs and partners throughout the information value chain, i.e., data availability, modelling and forecasting, institutional mechanisms to transform data into useable, value-added information, decision-support tools for sectoral applications, and, community outreach and feedback for addressing societal needs and contributing to sustainable development by enhancing resilience and disaster risk reduction and informed climate action.

Article 3 Financial Obligations

Financial obligations, if any, shall be determined by the Parties through mutual consultation and prior written agreement on a case-by-case basis, in accordance with the regulations of each Party.

Article 4 Settlement of Differences

Any differences between the Parties concerning the interpretation and/or application of this MoU shall be settled amicably through mutual agreement.

Article 5 Privileges and Immunities

Nothing contained in this MoU shall be deemed a waiver, express or implied, of any of the privileges and immunities enjoyed by WMO.

Article 6 Entry into Force, Amendment and Termination

(1) This MoU shall come into force upon the signature by the duly authorized representatives of both Parties and constitute an umbrella MoU under which specific projects/activities can be undertaken with details provided in annexes to be appended as and when formulated.

(2) This MoU may be amended by agreement of the Parties.

(3) This MoU may be terminated by either Party provided that six months' notice is given to the other Party. Termination of this MoU by either Party shall in no way affect previous obligations.

IN WITNESS WHEREOF, the undersigned have signed this MoU in two original, authentic copies in English.

For the
World Meteorological Organization
(WMO)



(Prof. Petteri Taalas)
Secretary-General

Date: 28.02.2022

For the
Regional Integrated Multi-Hazard Early
Warning System (RIMES)



(Ms. Khadeeja Naseem)
Minister of State for Environment
Climate Change and Technology of
the Maldives
On behalf of the Secretariat to RIMES

Date: 28.02.2022



WMO OMM

World Meteorological Organization
 Organisation météorologique mondiale
 Organización Meteorológica Mundial
 Всемирная метеорологическая организация
 المنظمة العالمية للأرصاد الجوية
 世界气象组织

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Our ref.: 17493/2023/MS/RAP

Annex: 1

Dr A.R. Subbiah
 Director, Program Unit
 Regional Integrated Multi-Hazard Early
 Warning System (RIMES)
 AIT Campus
 PO Box 4 Klong Luang
 Pathumthani 12120, Thailand

8 August 2023

Dear Dr Subbiah,

I have the honour to enclose herewith the WMO-RIMES Joint Strategy and Action Plan. I am convinced our two organizations will further strengthen our relationship in line with the Plan.

I look forward to WMO and RIMES working more closely together in the future to contribute to strengthening the capacities of National Meteorological and Hydrological Services (NMHSs), especially in those countries with the most vulnerable communities. Through closer and more strategic collaboration, we can further promote the critical role of NMHSs in providing services that mitigate against the increasing risks and impacts of weather, climate and water; and contributing to the achievement of the Sustainable Development Goals.

Our partnership approach to helping communities build resilience against climate change by implementing multi-hazard early warning systems by sharing resources, techniques and tools is in line with the United Nation's Early Warnings for All initiative and is therefore highly valued. In this regard, I thank you for your ongoing contribution to our common objectives.

Yours sincerely,

(Ben Churchill)
 Director, Regional Office for Asia
 and the South-West Pacific

EXECUTIVE SUMMARY

The WMO and RIMES' Joint Strategy and Action Plan (JSAP) is designed to contribute to Early Warnings for All initiative. JSAP aligns with the priorities of the [Paris Agreement](#), supports key provisions of the [Sendai Framework for Disaster Risk Reduction](#) contributes to the targets of the [2030 Agenda for Sustainable Development](#).

The JSAP keeps centrality of NHMS to deliver integrated services along all 5 pillars of information value chain in partnership with climate sensitive user stakeholders' institutions at National, Sub -National and local and community levels through innovative institutional mechanism.

JSAP fosters international and national partnerships to bring best of science, technology and management practices to the doorsteps of unreached countries and communities of differing capacities to achieve level playing field.

JSAP has inbuilt feedback process to ensure dynamic assessment of risks through regular socio-technical audits of Early Warning / Climate information systems to track risk trends and upgrade and finetune it to meet challenges posed by existing and emerging climate/geo-hazard risks. Hence JSAP will be the living document.

BACKGROUND

The World Meteorological Organization (WMO) and the Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES) have established a collaborative framework since the inception of RIMES in 2009-2010 through a Memorandum of Understanding (MoU). This leverages RIMES' technical and institutional resources to enhance the outreach of WMO programmes and projects in RIMES Member States, wherein RIMES serves as WMO's extension arm, interfacing between National Meteorological and Hydrological Services (NMHSs) and user institutions and communities through various collaborative programmes and projects that include the following:

- A joint WMO-RIMES 5-year program with the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) with support of USD 2 million was implemented from 2010 to 2015 to enhance multi-hazard early warning systems in high risk, low elevation coastal zones in some South and South-East Asian countries.
- From 2016 to 2020, RIMES implemented the WMO Global Framework for Climate Services (GFCS) project in South Asia and the Climate Risk and Early Warning Systems (CREWS) project in Southeast Asia supported by the Government of Canada.
- Since 2015, RIMES has been serving as Secretariat for the South Asian Seasonal Climate Outlook Forum (SASCOF) and facilitates the National Climate Outlook Forum (NCOF) in the South and Southeast Asia regions.
- Since 2021 RIMES has been serving as technical partner to provide FOCUS tool outputs for ASEAN Climate Outlook Forum (ASEANCOF).
- Since 2020, RIMES has served as Secretariat for the WMO-initiated World Bank-supported South Asia Hydromet Forum (SAHF).

The RIMES Council comprising the NMHSs of Member States in its 12th session resolution, appreciated the progress being made in the South Asia region and called upon RIMES to expand the program to other sub-regions such as Africa, Middle East, Central/Southeast/ East Asia and the Pacific. Furthermore, the Council expressed appreciation to WMO Secretary-General, Prof. Petteri Tallas, for his participation in the meeting and his commitment to further the WMO-RIMES collaboration and requested that a Strategy and Action Plan be developed jointly in this regard. Subsequently, WMO agreed to co-sponsor the 4th RIMES Ministers' Conference to be held in Sri Lanka, an opportunity for both RIMES and WMO to provide implementation thrust Joint Strategy and Action Plan (JSAP).

JSAP was evolved through intensive discussions of RIMES and WMO and West Pacific and Africa regional Directors and their teams during 2021 and 2022.

INTRODUCTION

Climate action is universally accepted as the most urgent priority in this rapidly changing world, where climate change is already affecting people from all walks of life. At the same time, increasing exposure and vulnerability in the societal systems have exacerbated socio-political and economic impacts of disasters, threatening sustainable development.

This interconnectedness of Climate Action, the Sendai Framework for Disaster Risk Reduction and the 2030 Agenda for Sustainable Development and the need for concerted actions brings to fore the centrality of NMHSs, which are uniquely situated to guide the proactive measures and actions underpinning each of these frameworks.



CENTRALITY OF THE NATIONAL METEOROLOGICAL & HYDROLOGICAL SERVICES
Key role across Disaster Risk Reduction, Climate Change Action and Sustainable Development
through tailored services for all sectors adopting a whole of government and whole of society approach

NMHSs provide highly visible and authoritative science-based information to respective governments to discharge one of their primary responsibilities of protecting life and property. In doing so, NMHSs need to adopt a whole-of-society approach, leveraging partnerships and engagement with both the public and private sectors.

The need for continued and enhanced engagement of NMHSs with user institutions is well recognized both due to the increasing exposure and sensitivity of the sectoral agencies and sectoral operations to weather and climate parameters. The unique position of NMHSs is also recognized for the provision of critical information that can guide informed decision-making processes of the user institutions, thereby enabling them to fulfil their own mandates and missions effectively.

This Joint Strategy and Action Plan is designed by WMO and RIMES with a view to enhance NMHSs' capacities to provide these vital, integrated services so that the socio-economic benefits of their services across all timescales are improved, tangible and will accrue across society.

VISION OF THE WMO-RIMES JOINT STRATEGY & ACTION PLAN

WMO and RIMES Member States are increasingly resilient to negative impacts of weather and climate while simultaneously capitalizing upon favorable manifestations of weather, climate and water for resilient and sustainable development.

STRATEGIC OBJECTIVES OF THE WMO-RIMES JOINT STRATEGY & ACTION PLAN BUILD ON THE CENTRALITY OF THE NMHSS

1. Facilitate capacity development of NMHSs to support their mandates at the country level and meet the information needs of Member States for effective Disaster Risk Reduction (DRR), undertaking urgent Climate Actions for resilient and sustainable development.
2. Promote and facilitate the development of effective support systems for decision-making across DRR, Climate Action and Sustainable Development domains by implementing innovative institutional mechanisms. This will be achieved using the climate information value chain and the whole-of-society and whole-of-government partnerships and collaboration approaches.
3. Ensure functional tools (developed by WMO and RIMES) and decision support systems are operationalized to guide evidence-based and risk-informed decision-making that draws upon the weather, climate and water services offered by NMHSs.
4. Contribute to strengthening the operational capacities and mechanisms of NMHSs for last-mile outreach to safeguard the lives and assets of citizens.
5. Foster international partnerships to ensure accessibility of best of technologies to all countries with differing capacities.
6. To ensure sustained and dynamic refinement of early warning/climate information systems through regular socio/ technical audits and feedbacks on the relevance and usability of climate/early warning services from stakeholder national and local institutions.
7. JSAP will be the dynamic and living document with regular updating of it.

STRATEGIC OBJECTIVE 1:

Facilitate capacity development of NMHSs to meet the information needs of Member States for effective Disaster Risk Reduction, undertaking urgent Climate Actions for resilient and sustainable development.

Investments on the upstream components of the weather and climate information value chain (depicted below) are perceived by policymakers to be higher than benefits. Enhancing the capacities of both NMHS and user institutions collectively covering both upstream and downstream components of the information value chain to correct and address this perception.



NMHS Information Value Chain (WMO)

Focus areas:

- Strengthening weather, climate and water observing networks by leveraging the Global Basic Observing Network (GBON)/Systematic Observations Financing Facility (SOFF) initiatives.
- Facilitating sharing of historical data for performance evaluation of past country-scale extreme weather forecasts.
- Enhancing availability of modelling and forecasting products for use by Member States for Impact-Based Forecasting (IBF) services and Decision Support Systems (DSSs).
- Promoting joint efforts in training activities through the Severe Weather Forecasting Project (SWFP) and Coastal Inundation Forecasting Initiative (CIFI) and FFGS.
- Facilitating incorporation of outputs available from advanced centres and WMO Regional Specialized Meteorological Centres (RSMCs).

STRATEGIC OBJECTIVE 2:

Promote and facilitate effective integration of NMHSs' information and services into decision-making across the Disaster Risk Reduction (DRR), Climate Action and Sustainable Development domains through development and implementation of innovative institutional mechanisms and decision-support systems. This will be achieved using the climate information value chain and the whole-of-society and whole-of-government partnerships and collaboration approaches.

Often the absence of vibrant and dynamic interface mechanisms between NMHSs and user institutions is a major barrier in providing climate information value chain services seamlessly. Incentive-based institutional mechanisms are thus essential to ensure that user institutions are engaged actively in the process by sharing data and domain expertise necessary for applications and reciprocally receive value-added services.

Focus areas:

- Transforming data into information through appropriate institutional mechanisms for co-production of services.
- Facilitating user-NMHS interactions to co-design products and services.
- Development of tools and methodologies to effect co-production and application of climate services for Agriculture/ Water Resources/ Public Health/ Power and other productive sectors and Disaster Risk Management.
- Enhancing outreach to policymakers with possible scenarios and opportunities for sustainable and resilient development planning.
- Joint engagement in Ministers' Conference in RIMES Member States through sponsorship, joint planning and active participation.

STRATEGIC OBJECTIVE 3:

Develop and operationalize functional tools and Decision Support Systems (DSSs) to guide evidence-based and risk-informed decision-making that draw upon the weather, climate and water services offered by NMHSs.

Utilize the latest and cutting-edge technologies such as artificial intelligence and machine learning-based data analytics to integrate the data flow from user institutions with the forecast data from NMHSs in the DSSs in the process of co-production of services.

Focus areas:

- Tailor-made services to deliver user/ decision-context-specific information for resource and risk management.
- Facilitating development and implementation of DSS for enhancing NMHS engagement with their key users, utilizing cutting-edge technologies.
- Demonstrating DSS capabilities in application areas (beyond early warning), e.g. transportation, water resources, tourism and other productive sectors.

STRATEGIC OBJECTIVE 4:

Contribute to strengthening the operational capacities and mechanisms of NMHSs and DRR institution for last-mile outreach to safeguard the lives and assets of citizens.

Forecasts need to be communicated clearly by explaining uncertainties to DRR and other users and at-risk communities. The risk communication approach should result in proactive actions necessary for deriving optimal benefits from the risk information.

Focus areas:

- Community Outreach through last-mile risk communication involving the Common Alerting Protocol (CAP), forecast-based action and feedback mechanisms.
- Demonstration projects linking with at-risk communities.

FINANCING THE WMO-RIMES JOINT STRATEGY & ACTION PLAN

WMO and RIMES will draw from existing funding sources and leverage partnerships with other development partners. Several regional or specific countries initiatives (e.g. Green Climate Funds – GCF; Climate Risk Early Warning Systems – CREWS), programmes and projects are underway or planned at both WMO and RIMES, which would directly address the focus areas and priorities identified in this Joint Strategy and Action Plan. Where necessary, additional resources would be mobilized jointly, in close consultation with Member States and development partners.

IMPLEMENTATION OF THE WMO-RIMES JOINT STRATEGY & ACTION PLAN

The implementation of the WMO-RIMES Joint Strategy and Action Plan will be initiated on a pilot basis immediately commencing from regions and countries where funding is already available. Progress/ results from the pilots will be presented at the 4th Ministers' Conference.

A phased plan of implementation covering all Member States commensurate with the articulated needs and demands will be drafted, building on the Action Plan.

The progress of implementation will be reported to, monitored and evaluated annually by the RIMES Council as well as by the appropriate WMO mechanisms and subsequent Ministers' Conferences.

ACTION PLAN TO OPERATIONALIZE THE JOINT STRATEGY

DESCRIPTION OF PROGRAMME ACTIVITIES	GEOGRAPHICAL COVERAGE OF PILOTS	FUNDING CONTRIBUTION				TIMELINES	RE-MARKS
		Total	WMO	RIMES	Gap		
COMPONENT 1: Observing Networks and Data							
Advancing the implementation of the Global Basic Observing Network (GBON)/ Systematic Observations Financing Facility (SOFF) initiatives, through demonstration of feasibility of GBON/SOFF in areas with large data coverage gap.	Southeast Asia and selected EWS4ALL 1 st Cohort countries (Asia, Pacific and Africa)						
Enhancing global forecast accuracy by sharing regional data with WMCs for their assimilation into products and services							
Facilitate sharing of historical data starting with Southeast and South Asia							
COMPONENT 2: Modelling and Forecasting							
Development and testing of research products for increased lead-time/ high-resolution forecasts	Select Regional Specialized Meteorological Centers in Africa and one or two relatively advanced centers -Mozambique, Kenya, Tanzania. Similarly in other regions, including through EWS4ALL						

DESCRIPTION OF PROGRAMME ACTIVITIES	GEOGRAPHICAL COVERAGE OF PILOTS	FUNDING CONTRIBUTION				TIMELINES	RE-MARKS
		Total	WMO	RIMES	Gap		
Enhance availability of NWP data and products directly to NMHSs for improved forecasts, decision support systems and post process for targeted user products	Selected EWS4ALL 1 st Cohort countries (Asia, Pacific and Africa)						
COMPONENT 3: Transformation of data into Information: Institutional Mechanisms for co-production of services							
Institutional forums for enhancing engagement with key sectors on forecast applications	South Asia and Southeast Asia and Pacific ongoing: program Africa and Middle East Asia will be initiated						
Develop tools and methodologies for NMHSs to effect co-production and application of climate services, in delivering WMO initiatives such as the specialized Climate Risk and Early Warning Systems (CREWS)	South Asia and Southeast Asia and Pacific ongoing: program Africa and Middle East Asia will be initiated						
Facilitate uptake of outputs and high-value information available from advanced centres and RSMCs	South Asia and Southeast Asia and Pacific ongoing: program Africa and Middle East Asia will be initiated						
Enhance outreach by NMHSs to policymakers in line with the whole-of-society approach	South Asia and Southeast Asia and Pacific ongoing: program Africa and Middle East Asia will be initiated						

DESCRIPTION OF PROGRAMME ACTIVITIES	GEOGRAPHICAL COVERAGE OF PILOTS	FUNDING CONTRIBUTION				TIMELINES	RE-MARKS
		Total	WMO	RIMES	Gap		
Joint engagement in Ministers' Conference in RIMES Member States through sponsorship, joint planning and active participation	South Asia and Southeast Asia and Pacific ongoing: program Africa and Middle East Asia will be initiated						
COMPONENT 4: Tailor made services to deliver user/ decision specific information for resource and risk management							
Facilitate development of Regional Data Analytics System (RDAS) & implementation of Decision Support Systems in collaboration with key user institutions in application areas extending beyond Early Warning, such as: - Spatial characteristics of Climate Change Mitigation & Adaptation actions - Climate smart agriculture - Climate informed infrastructure - Climate risk informed finance and planning - Integrated Public Health Management - Tourism - Transportation - Water Resources - Power sector	West Africa (Cote d'Ivoire, Burkina Faso) South Asia: program Africa and Middle East Asia , Central Asia and Pacific will be initiated			\$ 3,545,000			WB (CARE)

DESCRIPTION OF PROGRAMME ACTIVITIES	GEOGRAPHICAL COVERAGE OF PILOTS	FUNDING CONTRIBUTION				TIMELINES	RE-MARKS
		Total	WMO	RIMES	Gap		
Demonstration of DSS in Member States - Nepal: Roads; Agriculture; Finance & Planning; water resources management; disaster management - Bangladesh: finance and planning; agriculture; livestock; roads/ transport; water resources management - Pakistan: finance and development planning; agriculture; water resources management	South Asia			\$ 6,500,000			WB (CARE)
COMPONENT 5: Community Outreach- Last mile risk communication and Forecast based Action (based on threshold triggers) and Feedback							
Demonstration of last-mile and community outreach mechanisms for anticipatory actions	West Africa and South Asia, selected EWS4ALL 1 st Cohort countries (Asia, Pacific and Africa)						
Demonstration of communication of climate risk information for decision-making at community levels	Selected EWS4ALL 1 st Cohort countries (Asia, Pacific and Africa)						
COMPONENT 6: Training, Applied Research and Development							
Joint effort in training activities through Severe Weather Forecasting Project (SWFP), Coastal Inundation Forecasting Initiative (CIFI) and Flash Flood Guidance System (FFGS)							