



## Terms of Reference / Work Plan and Budget

ESCAP Multi-donor Trust Fund on Tsunami, Disaster and  
Climate Preparedness in Indian Ocean and  
Southeast Asia Asian countries

### A. Overview

1.	IMPLEMENTING ORGANIZATION	Regional Integrated Multi-Hazard Early Warning System (RIMES) for Africa and Asia and World Meteorological Organization (WMO)
2.	FOCAL POINT AT ORGANIZATION AND RELEVANT CONTACT INFORMATION	Ms Lolita Bildan, Chief, Program Management, RIMES Tel. 02-516-5901, E-mail: <a href="mailto:lolita@rimes.int">lolita@rimes.int</a> , <a href="mailto:lolita.bildan@gmail.com">lolita.bildan@gmail.com</a>  Mr Robert O. Masters, Director, Development and Regional Activities Department, WMO Tel: +41 22 730 8325, Fax: +41 22 730 8047 E-mail: <a href="mailto:RMasters@wmo.int">RMasters@wmo.int</a>
3.	PROJECT TITLE	Reducing risks of tsunami, storm surges, large waves and other natural hazards in low elevation coastal zones
4.	BENEFICIARY COUNTRIES	Bangladesh, India, Maldives, Myanmar, Sri Lanka and Thailand
5.	TARGET GROUP/ SPECIFIC LOCATIONS	<ul style="list-style-type: none"> <li>• National Meteorological and Hydrological Services (NMHSs) / National Tsunami Warning Centres (NTWCs)</li> <li>• National Disaster Management Offices (NDMOs)</li> <li>• Government sectoral agencies</li> <li>• Local authorities, NGOs and households in select high-risk areas</li> </ul>
6.	TIME FRAME	24 months
7.	TOTAL BUDGET (US\$) AND BREAKDOWN OF FUNDS	ESCAP Trust Fund: USD 1,818,274 Counterpart contribution: USD 1,388,040

### Executive Summary

About 3% of Asia's land area is classified as low elevation coastal zone, yet it is home to 13% of the region's population and 18% of its urban population. Of the top 10 countries in the world with largest population counts in low elevation coastal zones, eight are in Asia. Most are with heavily populated delta regions and are exposed to flood risks from rising tides, tropical storms, sea level rise, and combinations of high tides, large waves, storm surges and/or high river flows, in addition to tsunami. The poor and low-income groups are the most vulnerable. Despite these risks, coastal settlements, in particular urban, continue to attract more people and are growing more rapidly than inland, putting more people at risk to coastal hazards. Reducing risks through preparedness and mitigation is paramount, as migration away from these zones, though may be the most appropriate prevention measure, is not popular or acceptable.

The tsunami of 2004 stimulated an interest in and support to developing tsunami warning systems. Noting the general rarity of tsunamis in the region, a multi-hazard approach is necessary to be cost effective and ensure a sustainable warning system in the longer term. By covering high-frequency, but low impact coastal hazards, multi-hazard warning systems will be activated more often than a single-

hazard warning system, and provide better functionality and reliability for dangerous low-frequency, but high-impact events, such as tsunamis. Multi-hazard warning systems allow regular interaction between warning information providers and users. In most countries of the region, however, including Bangladesh, India, Maldives, Myanmar, Sri Lanka and Thailand, interaction is currently event response-based, hence disaster preparedness and response do not adequately meet the demands of situations created by emergencies. This was glaringly demonstrated by the enormous loss of lives (over 137,000 people dead or missing) and destruction wrought in Myanmar by tropical cyclone Nargis that struck on 2<sup>nd</sup> and 3<sup>rd</sup> May 2008; the environmental emergency that inflicted damage to homes, livelihoods and infrastructure in many parts of the Maldives as a result of large swell waves, which caused widespread flooding in the exposed islands during 15-18 May 2007; and, for the second time, large swell waves resulting from monsoon winds, which reached the Maldives during the period 17-19 June 2007, causing coastal flooding on its Northern Atolls.

The project aims to reduce tsunami, storm surges, large waves and other hazard risks in low elevation coastal zones by strengthening institutional systems for end-to-end warning, and building institutional capacities for the application of warning information products in decision-making. Key activities include:

- Institutionalizing early warning multi-stakeholder national forums, consisting of sectoral agencies, local institutions and authorities, and NGO and community representatives from select locations, to gather information and assess disaster risk management and emergency preparedness capacities in participating countries, and assist them in planning at national to local levels to be able to take proactive actions to reduce risks associated with coastal-related disasters, through the development of a basic set of standard operating procedures between the National Meteorological and Hydrological Services (NMHSs), other stakeholders, and communities at risk. These include regular review of the warning system performance, receive user feedback, and identify problems and actions needed for an improved end-to-end, multi-hazard, people-centred warning system.
- Catalyzing the institutionalization of regular user dialogues, involving national warning centre officials and high-risk (pilot) communities. These also provide opportunities for public education and awareness-raising, and evaluation of the “last mile warning”.
- Providing training and infrastructure to ensure that pilot communities are connected to the warning system, with institutional capacity to receive and disseminate warnings 24/7 through effective communication pathways and to respond to emergencies.
- Establishing institutional mechanisms for the receipt and translation of location-specific disaster risk information into impact outlook, preparation of response options, communication of this information to populations at-risk, monitoring of application in decision-making, and receiving feedback for system improvement.
- Training of disaster management and civil protection officers in vulnerable sectors, including disaster management committees, at national and sub-national levels, in the translation of location-specific disaster risk information into impact outlook and preparation of response options.
- Training of local project implementation working groups, consisting of the local disaster management committee and representatives of community-based organizations and pilot communities, in historical hazard impact, community and household vulnerability, coping strategy, and user need assessments; risk profile development; and determining thresholds for various hazard magnitudes and intensities.
- Facilitating better emergency preparedness and response by determining thresholds of risk areas and user requirements, to generate high-resolution location-specific disaster risk information, by generating and providing forecasting guidance and warning services for extreme coastal hazards events through improving NMHSs’ access to available and most relevant global Numerical Weather Prediction (NWP) and Ensemble Prediction System (EPS)-based products, including those for marine forecasting, from major NWP centres of WMO’s Global Data-Processing and Forecasting System (GDPFS).

- Training NMHSs in generating user-focused and tailored products and services for disaster risk reduction.
- Demonstration of the application of location-specific disaster risk information in decision-making to reduce disaster risks
- Annual regional sharing and learning workshop, targeting non-project countries, to share project experiences, practices, tools, methods, lessons and successes.

The following project outcomes are anticipated:

- Regular interactions of early warning institutions, disaster managers and communities through the biennial multi-stakeholder forums, regular user dialogues and early warning system checks at community level, and delivery, translation, communication and application of location-specific disaster risk information would keep community and stakeholder interests in tsunami warning and ensure that last mile communication systems are working.
- Early warning stakeholder institutions use the biennial multi-stakeholder forums to enhance inter-agency coordination, for planning, provide feedback and identify proactive actions to continuously improve the warning systems and to reduce risks associated with coastal-related disasters.
- Populations at-risk get access and understand information in decision-making to reduce disaster risks.

## **B. Need Assessment**

Low elevation coastal zones, i.e. coastal areas with elevations less than 10 meters above sea level, cover two percent of the world's land area, but contains 10 percent of the world's population and 13 percent of the world's urban population (refer to Table 1, Annex 2). Asia has 13 percent of its population living in low elevation coastal zones, which constitute only three percent of its total land area. Eight of the top ten countries with largest population residing in low elevation coastal zones are in Asia (refer to Table 2, Annex 2). Most are with heavily populated delta regions, and are exposed to flood risks from rising tides, tropical storms, sea level rise, and combinations of high tides, large waves, storm surges and/or high river flows. The poor and low-income groups are the most vulnerable. Despite these risks, coastal settlements, in particular urban, continue to attract more people and are growing more rapidly than inland, putting more people at risk to coastal hazards.

Migration away from these zones is a wise prevention measure, but not practical due to economic considerations. Reconstruction after the 2004 tsunami demonstrated the re-building in the same areas that suffered heavy toll. Reducing risks through preparedness and mitigation, in addition to policies that support inland urban development, then become the more acceptable option.

Coastal risk reduction involves actions at local, national and regional levels. Communities should have capacity to assess their risks and vulnerabilities, a periodically practiced emergency operations plan, infrastructure to receive and disseminate warnings, secure critical facilities, sustainable management of coastal and marine natural resources to prevent creation of new risks, diversified livelihoods to reduce dependence on coastal resources and enable them to bounce back more quickly from a disaster, and awareness of their risks and risk reduction measures. National, sub-national and local institutions provide an enabling environment for these to happen: regulations, policies, institutional and financial mechanisms that support risk reduction, and a robust early warning system that reaches communities at-risk. Regional and global institutions assist in developing institutional capacities and in bringing the best of science for local application to reduce risks.

The tsunami of 2004 provided impetus for development of tsunami warning systems. For most countries in the region, however, tsunami is a very infrequent hazard, hence the imperative to develop a

tsunami warning system within a multi-hazard framework. UNESCO/IOC recognizes that tsunami warning coordination and operation should be within a multi-hazard approach, to be cost effective and sustainable. By covering several types of hazards, in particular high frequency, but low impact hazards, multi-hazard warning systems will be activated more often than any single-hazard warning system, and therefore should provide better functionality and reliability for dangerous low frequency, but high impact events, such as tsunamis. Multi-hazard warning systems allow continuous interaction between warning information providers and users. Table 3, Annex 2 shows the common requirements of a tsunami and storm ready community and the possible entry points for integration.

Large swell waves resulting from monsoon winds in 2007, and storm surges associated with tropical cyclone Nargis in 2008, exposed institutional weaknesses at all levels in the generation, interpretation, translation, and communication of warning information, particularly for low-lying coastal zones prone to storm surges, large waves, and other coastal hazards, which this project seeks to address through specific capacity building initiatives.

Almost all of the countries in the Asian and African regions have the NMHSs as focal points for tsunami warning. NMHSs have the mandate for weather and related observations, forecasting, and issuing warning for marine-related hazards, including storm surges and large waves. Most NMHSs in the region are reasonably well-established, however, they have capacity gaps in relation to effective operations and in multi-hazard warning (refer to Table 4, Annex 2); adding tsunami warning, which is more demanding because of the very short lead time required, is a big challenge. It is therefore critical to build capacities of NMHSs and link them with the national disaster management community.

The WMO/ESCAP Panel on Tropical Cyclones (beneficiary countries – Bangladesh, India, Maldives, Myanmar, Sri Lanka and Thailand – are Members of this Panel), at its 33<sup>rd</sup> session (Dhaka, Bangladesh, February 2006), agreed that it is critical to ensure that the tsunami early warning system in the Indian Ocean is linked with the existing tropical cyclone early warning system and storm surge forecasting to maximize the benefits of these capabilities for saving of life and property in the coastal regions. A task force was established at its 35<sup>th</sup> session (Manama, Bahrain, May 2008) to implement the proposed multi-hazard early warning concept. In addition, the ESCAP/WMO Typhoon Committee, at its 40<sup>th</sup> session (Macao, China, November 2007), recommended the formulation of a conceptual framework consistent with Multi-Hazard Early Warning Systems. These developments in the regional arrangements to reduce disaster risks by multi-hazard approach will be benefited substantially by the implementation of this project.

The WMO/ESCAP Panel on Tropical Cyclones (PTC), at its 37<sup>th</sup> session (Phuket, Thailand, February 2010), noted the establishment of RIMES and its role in building capacity of its Member States for early warning of tsunami and other natural hazards. The relevant extract of the TCP report is as follows:

*“In this connection, the Panel noted that a regional early warning facility for Indian Ocean and South-East Asia was established with funding from the ESCAP Tsunami Regional Trust Fund and DANIDA, at the Asian Institute of Technology (AIT) campus in Pathumthani, Thailand. The facility is to build capacity for national early warning systems and enhance community resilience, i.e., to provide regional tsunami watch, to offer research and development support to NMHSs, and to enhance the capability of national systems to respond to early warning information at national, local, and at-risk community levels in line with the Hyogo Framework of Action. On 30 April 2009, the facility was reformulated as the Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES), an inter-governmental, international, non-profit organization, whose mandate is to provide regional tsunami watch and advisory services, and build capacity of its Member Countries for early warning of tsunami and other natural hazards. Maldives serves as the current Secretariat to RIMES, and the Programme Unit at AIT campus is responsible for day-to-day operation and management of the regional early warning*

*facility. Some Members of the Panel received localized disaster risk information from RIMES.”*

This project will address the following gaps:

- 1) An institutional system that allows regular interaction and dialogue among national warning information providers, such as the NMHS, disaster management organizations, and communities at-risk to keep the tsunami warning system active and communities alert. At present, interactions are mostly event response-based, hence disaster preparedness and response do not adequately meet the demands of situations created by emergencies. Table 3, Annex 2 shows that a minimum of twice a year meetings would be required for developing and sustaining tsunami- and storm-ready communities. At-risk community participation and feedback are essential in these meetings to ensure that warning reaches the last mile, is responded to, and is relevant to user needs.

Of the 26 countries participating in the RIMES-facilitated early warning system, Bangladesh and Philippines have this experience through demonstration projects in seasonal climate forecast application, supported by USAID’s Office of Foreign Disaster Assistance (USAID/OFDA); and Cambodia and Vietnam through demonstration projects in enhancing coastal community resilience to natural disasters, supported by DANIDA. For Bangladesh, the experience needs to be extended to tsunami warning. Table 5, Annex 2 lists these initiatives.

Support from the ESCAP Trust Fund for Tsunami, Disaster and Climate Preparedness is being sought, through this project, for Bangladesh, India, Maldives, Myanmar, Sri Lanka and Thailand. These countries have poor and low-income groups in low elevation coastal zones that are vulnerable to inundation from high tides, large waves, storm surges, or high river flows (refer to Table 9, Annex 2), and were affected by the 2004 Indian Ocean tsunami. They are members of the RIMES and expressed interest to participate in the project (refer to Annex 6).

- 2) Warning information products that are usable in decision-making, around which regular interaction between warning provider and communities at-risk would be centred, compared to the current event-based interaction. Development of these products need to consider user needs in terms of content, language, lead time, timing and channel of delivery. Table 6, Annex 2 shows the various institutions involved in the generation and delivery of tsunami and hydro-meteorological warning information.

Further, the project addresses capacity gaps identified in the pilot countries (refer to Table 4, Annex 2), which relate to the critical areas of downscaling to generate location-specific warning information, and in interpreting and translating such information to user-friendly formats for local level applications.

It is to be noted that the role of RIMES is to provide research and development support to fill gaps in the regional and /or national systems. It aims to complement WMO operational arrangements for the provision of weather and related forecasting products, by translating severe weather and related forecast research and development into improved operational forecast products and application by Member Countries. In collaboration with WMO’s Public Weather Services Programme, RIMES also facilitates a strengthened interface between operational forecasters and disaster managers, by enhancing the latter’s capability to utilize operational forecast products for making informed decisions for reducing disaster risks.

Within this project, WMO is expected to implement a severe weather and related forecasting system for the Bay of Bengal region, focused on extreme weather and related phenomena, including strong winds, heavy precipitation, large waves and storm surges. Within the framework of WMO scientific and technical programmes, the NMHSs in the Bay of Bengal region will benefit from the cascading concept of the forecasting process, which would help developing countries and LDCs to access and implement the most relevant global Numerical Weather Prediction (NWP) and Ensemble Prediction Systems

(EPS)-based products, including those for marine forecasting, from the WMO's Global Data-Processing and Forecasting System (GDPFS), for improving warning services to end-users and generating specific and localized disaster risk information.

RIMES is also recognized by ICG/IOTWS, at its 5<sup>th</sup> session (Kuala Lumpur, Malaysia, April 2008), as a potential regional tsunami watch provider (RTWP) in its network of inter-operable system of RTWPs. RIMES is working towards full recognition as an operational RTWP and, in this regard, adheres to ICG/IOTWS standards and requirements, and ensures that activities complement and are coordinated with ICG/IOTWS. ICG/IOTWS, at its 7th Session (Banda Aceh, April 2010), requested RIMES to exchange tsunami early warning information with other RTWPs in the region.

The project will complement and build on ongoing efforts in the target countries, such as by UNESCO/IOC on developing tsunami standard operating procedures in Myanmar, and UNDP on establishment of Emergency Operations Centres (EOCs) and last-mile preparedness in small island communities in the Maldives. A simulation exercise through this project can test these, identify gaps and support critical actions needed to address gaps.

The RIMES Executive Board, in its meeting held in Bangkok (April 2010), evolved a Master Plan to be implemented in the next 5 years (2010-2014). Addressing coastal hazards in low elevation coastal zones has been adopted as one of the priority regional programs for RIMES Member States (Annex 11-RIMES Master Plan).

This project also addresses comprehensive risk assessments, education and public awareness, and local level pilot demonstration activities, which are among the key needs identified in the "Report on Regional Unmet Needs and Recommendations: Tsunami Early Warning Systems (TEWS) in the Indian Ocean and Southeast Asia".

Importantly, this project addresses the TEWS within a multi-hazard framework to ensure long-term sustainability of TEWS, and community preparedness and response strategies.

### **C. Problem Analysis and Project Design**

National stakeholder meetings were conducted in Maldives, Myanmar and Sri Lanka from June – September 2006, with support from the UN International Strategy for Disaster Reduction (UNISDR), to clarify stakeholder roles in end-to-end multi-hazard warning, identify gaps in their warning dissemination systems, and recommend a set of actions for improvement, with an overall goal of improving community response to warnings. In Thailand, noting the need to build the National Disaster Warning Centre's (NDWC) capacity, a training workshop was conducted in August 2006 on disaster risk communication, with particular focus on target warning recipients, warning content, inter-agency coordination and user feedback, to complement the Tsunami Alert Rapid Notification System (TARNS) initiative of the US Indian Ocean Tsunami Warning System (US-IOTWS) programme.

These stakeholder meetings brought together, in a dialogue, institutions involved in generating warning information for tsunamis, large waves, storm surges and other natural hazards experienced in low elevation coastal areas, institutions that deliver these information to communities at-risk, institutions and organizations that utilize these information to assist during emergencies, and representatives from communities who were most affected by the December 2004 tsunami. For Maldives, Myanmar and Sri Lanka, the meetings were the first of its kind that involved a wide range of stakeholders, including community representatives. A key recommendation of these meetings is periodic stakeholders meetings to review system performance, receive user feedback, and identify problems and actions needed. Annex 3 provides the summary report of these meetings and training workshop, which includes the names of participating government and non-government organizations.

These meetings and training workshop also identified the following gaps, among others:

- Internal linkages between departments within and among stakeholder institutions;
- Information gaps from warning centres cause loss in media credibility;
- More accurate, area-specific, concise, clear/ not confusing user-friendly warnings;
- Information on anticipated duration of threat;
- Language of warning messages;
- Targeted warning in hazard-prone areas;
- Warning dissemination channels;
- Research and development capacity.

The project was then designed to meet the gaps identified above, with the following key components and elements:

1. Strengthening institutional capabilities at national and regional levels for end-to-end warning systems for tsunamis, storm surges, large waves and other natural hazards:
  - a. At least twice a year stakeholder forums to review system performance, receive user feedback, and identify problems and actions needed.
  - b. Local communities are capacitated to:
    - i. Receive warnings 24/7. Warning points are established in select communities and connected to warning institutions from national to local levels, and able to receive and disseminate warnings through effective communication pathways;
    - ii. Respond to emergencies. Emergency Operations Centres are established, trained and practiced.
  - c. At least twice a year visits by national warning centre officials to local communities to ensure functionality and effectiveness of the end-to-end warning systems.
2. Building institutional capacities for the application of warning information products in decision-making:
  - a. Training of users in the translation of these products for decision-making;
  - b. Demonstration of the transmission, translation and application of these warning information products in select low elevation coastal locations for risk reduction.

Targeted NMHSs in Bangladesh, India, Maldives, Myanmar, Sri Lanka and Thailand endorsed the above project design and adopted this programme in their participation in the RIMES Executive Board meeting (April 2010) (Annex 6- Extract from RIMES Executive Board Meeting & Annex 11 - RIMES Master Plan).

#### **D. Target Group**

The institutions listed in Table 6, Annex 2, including non-government and local institutions and select communities, are targeted by the project. These institutions include the national focal points for warning of tsunamis, storm surge, large waves and other natural hazards, technical institutions involved in warning generation, institutions involved in responding to emergencies, institutions involved in disseminating warning information, local authorities, and select communities.

## E. Project Strategy

The project would demonstrate methods and tools that institutions and stakeholders in the target countries could adopt, sustain, and replicate to upscale impacts. The project will build on the stakeholder meetings held in 2006 in the target countries, and would be expanded to include non-government organizations involved in disaster risk reduction, local authorities, and representatives of at-risk communities. Demonstrations will be conducted in two select coastal communities in each country. A preliminary list of sites is attached as Annex 7, which would be finalized in consultation with the national focal points.

Demonstration of the application of tailored location-specific warning/ disaster risk information in decision-making will use global Numerical Weather Prediction (NWP) and Ensemble Prediction Systems (EPS)-based products, including those for marine forecasting, from the WMO's Global Data-Processing and Forecasting System (GDPFS), for improving warnings service to end-users and generating location-specific disaster risk information. Downscaling factors are geophysical parameters, such as bathymetry and inland topography, soil characteristics, land use, etc. WMO and RIMES will facilitate training of NMHSs in preparing and providing downscaled products, user-focused, and tailored information for use by disaster managers. WMO's Public Weather Services Programme and RIMES curricula on user training in warning information translation shall be adapted for each target country. RIMES will use its experience, good practice, and lessons learnt from its demonstration projects in Bangladesh, Indonesia, Philippines, and Vietnam in facilitating institution and capacity building.

The project will take an integrated multi-hazard approach to early warning in all target countries, recognizing that impacts of inundation on coastal areas are similar, though of different hazard sources. In Maldives, early warning for more recurrent large waves and storm surges will be improved and linked to the tsunami warning. In Myanmar, efforts will focus on addressing weaknesses exposed by Cyclone Nargis and its associated storm surges, which includes institutional capabilities to respond to warnings. In Sri Lanka, the project will take stock of all efforts by various organizations and how these have enhanced institutional and community preparedness, and identify gaps and actions to address gaps. In Thailand, focus will be given on enhancing synergy between warning systems for tsunami and storm-related coastal inundation.

## F. Results Framework

### i. Project activities

**Expected Outcome 1:** Regular multi-stakeholder national forums, involving sectoral agencies, local institutions and authorities, and NGO and community representatives from select locations, gather information and assess disaster risk management and emergency preparedness capacities in participating countries, and assist them in planning at national to local levels to be able to take proactive actions to reduce risks associated with coastal-related disasters, through the development of a basic set of standard operating procedures between the NMHSs, other stakeholders, and communities at risk. These include regular reviews of the warning system performance, receiving user feedback, and identifying problems and actions needed for an improved end-to-end, multi-hazard, people-centred warning system, established and functioning in the target countries.

1.1 Assist BMD (Bangladesh), IMD (India), DoM (Maldives), DMH (Myanmar), DoM and DMC (Sri Lanka), and TMD and NDWC (Thailand) in establishing early warning multi-stakeholder national forums that involve sectoral agencies, local institutions and authorities, and NGO and community representatives from select locations to:

- receive warning information user feedback to improve the country's tsunami, large waves, storm surges and other hazard early warning system;

- evaluate system performance and provide recommendations;
- receive information on the climate and hydrological outlooks in the incoming season;
- develop a plan of action in response to the outlooks;
- establish early warning forums at sub-national and local levels.

Agenda of these forums would be designed to ensure that feedback received from warning information user agencies and communities (refer to activities under expected Outcomes 2 and 3) are reported, actions taken by concerned agencies are documented, and impacts on policy and/or institutional arrangements are highlighted.

RIMES's professional experts' experiences over 10 years in Indonesia, Philippines and Bangladesh, in working with such multi-stakeholder forums at national and sub-national levels illustrates the efficacy of such approach. Annex 8 details the process in which such forums in Indonesia, Philippines and Bangladesh have been able to both contribute to enhancing the communities' preparedness capabilities and learn from their involvement in pilot communities, which understood the utility of (and demanded) localized information resulting in systems being developed and sustained to meet such demands, while also successfully up-scaling and replicating the approach in other vulnerable areas.

Indicator: A multi-stakeholder early warning national forum established in each target country

1.2 Provide technical inputs and guidance to the national forums. National focal points will organize the forums, preferably before the start of the monsoons/ storms, to prepare for the monsoon/storm season, evaluate institutional responses to forecasts and actions in the previous season, and recommend warning system adjustments. Recommendations and residual gaps from the national workshops on disaster risk communication (Annex 3) would be a good starting point. The benefits of the national forum need to be demonstrated to convince stakeholders of its importance, both economically and for public safety.

Indicator: At least 6 multi-stakeholder national forums organized, with participation of and recommendations from local institutions and authorities, NGOs and representatives from select at-risk communities

1.3 Catalyze the institutionalization of regular user dialogue and evaluation of the end-to-end warning system at community level from visits of national warning center officials to select communities. Visits can be timed during "normal and quiet" times. This is an additional way to sustain community attention to the warning system. The visits are also opportunities for public education and awareness-raising.

Indicator: At least twice a year visits made in each select community, and wider user feedback received

**Expected Outcome 2:** Selected communities at-risk are connected to the warning system, with institutional capacity to receive and disseminate warnings 24/7 through effective communication pathways and to respond to emergencies

2.1 Establish 24-hour warning points in select communities and connect them to local and national institutions for warning to ground TARNS

Indicator: At least 12 warning points connected to the early warning system at sub-national and national levels

2.2 Establish, train and practice Emergency Operations Centres (EOC) in select communities.

Indicator: At least 100 EOC volunteers trained in emergency operations

2.3 Ensure that select communities are able to receive and disseminate warnings through at least 3 effective communication pathways through TARNs. Support for low-cost communication systems will be provided according to the need of the community and financial capability of the target country.

Indicator: At least 3 communication pathways for receiving and disseminating warnings established at each EOC, and tested

**Expected Outcome 3:** Selected communities at-risk use location-specific warning information products (generated and demonstrated as detailed in activities under Outcome 4)

3.1 Constitute sub-national and local working groups. Sub-national and local working groups will be responsible for the translation of location-specific warning into impact outlook and response options, and in communicating disaster risk to communities at-risk, respectively.

Indicator: At least 12 sub-national and local working groups established

3.2 Train local working groups in the assessment of historical hazard impacts, community and household vulnerabilities, coping strategies, and user needs, using adapted RIMES curriculum.

Indicator: At least 12 local working groups trained in impact, vulnerability, capacity and user need assessments

3.3 Select coastal demonstration sites:

(a) In collaboration with NMHSs, RIMES and the local working group will collect and analyze historical disaster information to selected locations that are most at risk to tsunamis, large waves, storm surge and other hazards.

(b) RIMES and the local working group will assess historical hazard impacts, community and household vulnerabilities, and coping strategies.

(c) RIMES and the local working group will develop the site risk profile using assessment results.

Indicator: At least 12 demonstration locations with risk profiles prepared

3.4 Using the risk profile, the local working group, RIMES and NMHSs will determine thresholds for various hazard magnitudes and intensities

Indicator: Thresholds for various hazard magnitudes and intensities in at least 12 sites identified

3.5 RIMES and the local working group will assess local user needs for warning information, with respect to intended use, content, language, lead time, timing and channel of delivery. The activity would utilize RIMES's rich experience in using participatory tools to engage with communities, such as user need assessment, forecast lead time needs, disaster impact management plans for livelihood protection, and integration of forecast information into decision calendars. Table 7 in Annex 2 is one such matrix developed in Bangladesh under an on-going project. These will guide generation of tailor-made warning information products and also the application of disaster risk information listed in Activity 3.11.

Indicator: Warning information needs in at least 12 communities identified

3.6 Train disaster managers in vulnerable sectors (e.g., general public, agriculture, fisheries, water resources), including disaster management committees, at sub-national and local levels in the translation of disaster risk information into potential impacts for preparation of response options and communication to users

Indicator: At least 90 disaster managers trained in preparing impact outlooks and response options based on localized disaster risk information

**Need for interpretation and translation of hazard impacts:  
Case of Tropical Cyclone Nargis in Myanmar, May 2008**

Tropical Cyclone Nargis, which heavily affected Myanmar in May 2008, revealed gaps in capacities to translate hazard parameters into potential impacts at the local level.

As per the Post-Nargis Joint Assessment (PONJA) report of the Government of the Union of Myanmar, the Association of Southeast Asian Nations (ASEAN), and the United Nations (UN), Nargis killed over 84,530 people, with a further 53,836 still reported missing, and a scale of damage and losses similar to the impacts caused by the 2004 Indian Ocean Tsunami. The cyclone and associated storm surges destroyed about 450,000 homes and damaged 350,000 others. About 75 per cent of health facilities in the affected areas were destroyed or severely damaged, together with around 4,000 schools. The cyclone wiped out the livelihoods of families overnight, flooding over 600,000 hectares of agricultural land, killing up to 50 per cent of draught animals, destroying fishing boats, and sweeping away food stocks and agricultural implements. All this was despite the lead time provided by the Department of Meteorology and Hydrology.

While existing vulnerabilities and severity of the cyclone winds are some reasons for this, it is also true that the public was not aware of the potential impacts such a strong cyclone could cause, since they have not yet borne the brunt of a direct hit such as in the case of Nargis. The forecast may have conveyed the wind speed, storm surge potential, large waves, and rainfall expected, but the translation and interpretation of such hazard parameters into damage scenarios were missing. In case of the housing sector, this meant that the public were not aware at large of the possible precautions that they needed to undertake, except taking shelter in dwellings, which were not strong enough to bear the force of such severe winds from Nargis. Similarly, precautions for sectors such as agriculture and fishing, among others, were not identified and applied.

3.7 Demonstrate the application of location-specific disaster risk information in decision-making to reduce disaster risks in collaboration with the target communities and support institutions. This will be based on interactions with the community through the steps outlined under Activity 3.5 and will involve the following iterative steps:

- a) NMHSs deliver the downscaled, location-specific disaster risk information to the demonstration locations;
- b) Disaster managers in vulnerable sectors translate the information into impact outlooks;
- c) Based on the impact outlook, disaster managers in consultation with the relevant stakeholders at all levels - national, local and target community, prepare response options and communicate the disaster risk information, impact outlook and possible response options to local institutions and authorities;
- d) Local institutions and authorities communicate all these information to the community;
- e) Local institutions and authorities further refine possible response options to cater to the needs of the community;
- f) Community and household level responses and implementation of response options;
- g) Local institutions and authorities monitor and document responses and feedback from local and community levels;
- h) Local institutions and authorities communicate user feedback to disaster managers, who in turn communicate to NMHSs;
- i) System adjustment by disaster managers and NMHSs based on feedback.

Matrices, detailing the steps in this end-to-end process being applied for a particular case in Bangladesh, are annexed as Tables 7 and 8, Annex 2. A communication strategy complementing the process described in a) to e) above is presented in Annex 10.

Indicator: At least 12 communities demonstrated improved response to warning/ disaster risk information issued by NMHSs

3.8 Undertake evaluation, research and tool development to improve early warning system performance. The evaluation will focus on the entire system: from warning generation to community responses.

Indicator: Warning system gaps identified in at least 12 locations

**Expected Outcome 4: Generation of location-specific warning information products, through the established WMO infrastructure including the RSMCs, with support from trained government institutions and local disaster management organizations**

4.1 Within the framework of WMO scientific and technical Programmes, analyze available and most relevant global Numerical Weather Prediction (NWP) and Ensemble Prediction System (EPS)-based products, including those for marine forecasting, from major NWP centres of the WMO's Global Data-Processing and Forecasting System (GDPS), such as ECMWF, NCEP, UKMO, CMA, JMA, KMA and IMD, and enhance the role of a suitable regional meteorological centre for synthesizing all available and relevant products and information to provide daily severe weather and related forecasting guidance for the region of demonstration, in collaboration with all stakeholders, such as RSMCs, NMHSs and RIMES.

Indicator: Most relevant NWP techniques and products identified and analysed for further cascading forecasting process (at least from 3 global centres)

4.2 In collaboration with WMO Regional Centres and NMHSs, assess/define the necessary data and products required for location-specific disaster risk information products

Indicator: Data and products assessed (at least from 3 centres) as inputs for downscaling and documented

4.3 In collaboration with WMO Regional Centres and NMHSs, evaluate selected NWP and EPS-based products, including those for marine forecasting, by comparing outputs with observations and bias removal using statistical techniques with location-specific data

Indicator: Uncertainties in forecasting products (at least from 3 centres) evaluated and documented for local application

4.4 Downscale for high-resolution location-specific disaster risk information, combining thresholds of risk areas and user requirements, in collaboration with WMO Regional Centres and NMHSs, for use by disaster managers for targeted response

Indicator: Downscaled high-resolution disaster risk information generated (at least from 3 centres) and used by disaster management institutions in assessing potential impacts and possible response options

4.5 Train NMHSs in the generation of user-focused and tailored location-specific disaster risk information through workshops and secondment arrangement, in collaboration with RIMES.

Activities under Outcome 4 will be implemented by WMO, NMHSs, and global NWP and regional meteorological centres. In this regard, meetings will be required to establish a demonstration project

management team from WMO, develop a regional project implementation plan with all participating centres, and conduct mid-term review and evaluation.

Indicator: At least 2 NMHS scientists from each target country demonstrate ability to produce tailored location-specific disaster risk information

**Expected Outcome 5:** Countries in the Indian Ocean and Southeast Asia, which are not targeted by the project, learning from project experience, lessons and successes, express interest to replicate methods and tools

5.1 Conduct annual regional sharing and learning workshop, open for participation by other Indian Ocean and Southeast Asian countries to share project experiences, practices, tools, methods, lessons and successes

Indicator: At least 5 new countries participate each year, and share which tool, method, practice, etc. may be replicated

5.2 Share project outcomes, lessons and successes in the biennial ICG/IOTWS meetings

Indicator: 6 country reports shared with ICG/IOTWS

5.3 Document process, experiences and lessons learned, and periodically report progress to Regional Steering Committee, ESCAP Trust Fund for Tsunami, Disaster and Climate Preparedness Advisory Council, UNESCO/IOC, national, regional and international forums as opportunity arises, and the general public through RIMES website and quarterly newsletter.

Indicator: At least 10 institutions informed of project progress, experiences and lessons

## **ii. Capacities developed**

The project aims at:

Reducing tsunami, storm surges, large waves and other hazard risks in low elevation coastal zones by strengthening institutional systems for end-to-end warning, and building institutional capacities for the application of warning information products in decision-making processes.

Indicators:

- Number of communities, local institutions and NGOs actively contributing towards an improved end-to-end early warning system for tsunamis, storm surges, large waves and other natural hazards;
- Number of communities that receive warnings 24/7 through effective communication pathways;
- Number of communities that use warning information products in decision-making to reduce risks;
- Number of NMHSs scientists with demonstrable ability to produce tailored location-specific disaster risk information
- Number of country representatives in the Indian Ocean and Southeast Asia that are able to articulate good practice and lessons from the project.

**Intended results at various levels are tabulated as below:**

	<b>Expected Outcomes</b>
<b>Regional level</b>	Tsunami, large waves, storm surges and other hazard risks in low elevation coastal zones reduced by strengthening institutional systems for end-to-end warning, and building institutional capacities for the application of warning information products in decision-making processes
	A system incorporating available global and regional guidance products to generate location-specific disaster risk information demonstrated and applied for the first time in the region
	A regional mechanism would be in place for continuous improvement of regional model performance and capacity building, for transferring those improvements to countries in the region
	Countries in the Indian Ocean and Southeast Asia, which are not targeted by the project, learn from project experience, lessons and successes
<b>National level</b>	Regular multi-stakeholder national forums, involving sectoral agencies, local institutions and authorities, and NGO and community representatives from select locations, that review warning system performance, receive user feedback, and identify problems and actions needed for an end-to-end, multi-hazard, people-centred warning system are established
	NMHSs are trained in the generation of user-focused, tailored, and location-specific disaster risk information
	Capacity developed in national government institutions and local disaster management organizations to apply location-specific warning information
	Disaster managers in vulnerable sectors (e.g., general public, agriculture, fisheries, water resource) are trained in the translation of disaster risk information into potential impacts for preparation of response options and communication to users
<b>Sub-national level</b>	Sub-national working groups created and are capacitated to translate location-specific warnings into impact outlooks and response options
<b>Local level</b>	Select at-risk communities are connected to the warning system, with institutional capacity to receive and disseminate warnings 24/7 through effective communication pathways
	Select at-risk communities use location-specific warning information products to respond appropriately

### **iii. Expected project outcomes**

1) Regular interactions of early warning institutions, disaster managers and communities through biennial multi-stakeholder forums, regular user dialogues, and early warning system checks at community level, and delivery, translation, communication and application of location-specific disaster risk information would keep community and stakeholder interests in tsunami warning and ensure that last mile communication systems are working.

Indicators:

- At least 15 technical institutions, sectoral agencies, sub-national and local institutions and authorities, NGO and pilot community representatives participating in each national multi-stakeholder forums
- NMHS and national warning agency visit pilot communities twice a year for a user dialogue, warning system evaluation (with particular focus on last mile communication), and awareness raising
- At least 8 sub-national working groups are able to translate location-specific disaster risk information from NMHS into impact outlook and response options, and communicate these to local working groups

- At least 8 local working groups communicate location-specific disaster risk information, impact outlook and response options to more than 80% of households in the pilot community
- 2) Early warning stakeholder institutions use the biennial multi-stakeholder forums to enhance inter-agency coordination, receive seasonal climate and hydrological outlooks for use in planning, provide feedback and identify actions to continuously improve tsunami, large waves, storm surges and other hazard warning

Indicator: At least 10 national forum meetings received reports on actions taken by stakeholder institutions vis-à-vis recommendations and plan of action from previous forum

- 3) Population at-risk use location-specific disaster risk information in decision-making to reduce disaster risks.

Indicator: At least 8 communities provide feedback on receipt of information, actions taken, and recommendations for improvement

### G. Organizational Capacity

RIMES Professionals have two decades of experience in disaster management, facilitating regional cooperation, and building capacities of disaster management institutions at all government levels, disaster management practitioners, and communities. The table below provides details of skills and qualifications of the project staff that would be involved in the project.

<i>Position name</i>	<i>Reporting line</i>	<i>Responsibilities</i>	<i>Key qualifications</i>
Director, RIMES Program Unit (RIMES Contribution)	RIMES Secretariat	<ul style="list-style-type: none"> <li>• Provides strategic direction</li> <li>• Builds institutional partnerships for the project</li> <li>• Provides technical guidance to multi-stakeholder early warning national forums, early warning system evaluation and development, and piloting application of warning information products</li> <li>• Project monitoring and evaluation</li> <li>• Advocates with national level institutions and with RIMES Council for sustaining project initiatives</li> </ul>	<ul style="list-style-type: none"> <li>• 35 years experience in implementing development programs</li> <li>• 25 years experience in disaster risk management</li> <li>• 15 years experience in building institutional capacities for applying early warning information in decision-making</li> </ul>
Forecast Application Scientist	Director, RIMES Program Unit	<ul style="list-style-type: none"> <li>• Provides technical assistance to NMHSs in establishing and organizing early warning forums</li> <li>• Coordinates with institutions involved in early warning generation and dissemination until the local level for developing user feedback mechanism and integrating this into the early warning system</li> <li>• Assists country partners in establishing 24-hour warning points in select communities</li> </ul>	<ul style="list-style-type: none"> <li>• 6 years field experience in the application of short and medium term and seasonal climate forecasts for disaster risk management and resource management</li> <li>• 6 years experience in building capacities of institutions in warning information application</li> <li>• 6 years experience in early warning system development</li> <li>• 6 years experience in developing decision-support tools for improving early warning</li> </ul>

		<p>and ensures that these are connected to local and national early warning institutions</p> <ul style="list-style-type: none"> <li>• Ensures that forecast products and other warning information are received by EOCs and disseminated locally</li> <li>• Guides local partners in forecast product interpretation and translation, communicating early warning and risk information, and receiving feedback</li> <li>• Trains local partners in impact, vulnerability, capacity, and user need assessments</li> <li>• Guides local partners in selecting demonstration sites</li> <li>• Provides inputs for determining thresholds for various hazard magnitudes and intensities</li> <li>• Provides inputs to development and contributes to the delivery of training on forecast information interpretation and translation, and communication and application of risk information and response options</li> <li>• Guides the demonstration of location-specific risk information in reducing disaster risks and managing resources in pilot communities</li> <li>• Provides progress updates</li> </ul>	dissemination and risk communication systems
Senior Scientist	Director, RIMES Program Unit	<ul style="list-style-type: none"> <li>• Integrating global climate model outputs for generating location-specific hazard risk information</li> <li>• Trains, guides and assists NMHSs in generating, location-specific and user-relevant hazard risk information</li> <li>• Receives user feedback and subsequently improves early warning information products</li> <li>• Provides inputs to development and contributes to the delivery of training on forecast information interpretation and translation, and communication and application of risk information and response options</li> </ul>	<ul style="list-style-type: none"> <li>• 22 years experience in numerical weather prediction</li> <li>• 5 years experience in generating user-specific weather and climate forecast products</li> <li>• 5 years experience in building capacity of forecasters in the Asian region in numerical weather prediction and climate downscaling</li> <li>• 5 years experience in assisting countries develop their weather and flood forecasting systems</li> </ul>
Climate Scientist	Director, RIMES Program Unit	<ul style="list-style-type: none"> <li>• Trains, guides and assists NMHSs in generating, location-specific and user-relevant hazard risk information</li> </ul>	<ul style="list-style-type: none"> <li>• 15 years experience in numerical weather prediction</li> <li>• 5 years experience in generating user-specific weather and climate forecast products</li> </ul>

		<ul style="list-style-type: none"> <li>• Receives user feedback and subsequently improves early warning information products</li> <li>• Undertakes post-processing of model outputs to integrate into decision-support tools</li> <li>• Provides inputs to development and contributes to the delivery of training on forecast information interpretation and translation, and communication and application of risk information and response options</li> </ul>	<ul style="list-style-type: none"> <li>• 5 years experience in building capacity of forecasters in the Asian region in numerical weather prediction and climate downscaling</li> <li>• 5 years experience in assisting countries develop their weather and flood forecasting systems</li> </ul>
Trainer, Disaster Management	Director, RIMES Program Unit	<ul style="list-style-type: none"> <li>• Designs training program and develop country-specific training materials for EOCs</li> <li>• Adapts RIMES training materials for developing country-specific manuals on early warning information translation, communication, and application</li> <li>• Organize and deliver training</li> <li>• Receives feedback for improvement of training program and materials</li> </ul>	<ul style="list-style-type: none"> <li>• 5 years experience in curriculum development, and training delivery and evaluation</li> </ul>
Project Coordinator	Director, RIMES Program Unit	<ul style="list-style-type: none"> <li>• Coordinates and monitors implementation of all project activities</li> <li>• Assists the Forecast Application Scientist in implementing local level activities</li> <li>• Contributes to the training of EOCs and local partners in early warning information translation, communication and application</li> <li>• Contributes to project monitoring and evaluation</li> <li>• Ensures timely and high quality delivery of project outputs</li> <li>• Generates progress reports and ensures that these are submitted on time, with sound content, good quality, and in appropriate format</li> <li>• Contract management</li> <li>• Documents good practices and lessons learned from project implementation</li> <li>• Packages lessons, good practices, successes for wider dissemination through RIMES information channels (newsletter, website) and other avenues</li> </ul>	<ul style="list-style-type: none"> <li>• 8 years experience in project management</li> <li>• 8 years experience in implementing development programs</li> <li>• 8 years experience in disaster risk management</li> <li>• 5 years experience in implementing climate risk management projects in Asia, Africa, South America, and Europe</li> </ul>
Administrative	Project Coordinator	<ul style="list-style-type: none"> <li>• Travel arrangements</li> </ul>	<ul style="list-style-type: none"> <li>• 8 years experience in providing</li> </ul>

and Financial Coordinator		• General administrative support	general administrative and financial support to project staff
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The RIMES Master Plan (2010-2014) was prepared by the target countries to cooperate in establishing multi-hazard early warning systems. The methodology for the demonstration of the generation and application of disaster risk information for disaster mitigation has been tested and proven successful by RIMES Professionals involved in Extreme Climate Events (Indonesia, Philippines and Vietnam, 1998-2003), Climate Forecast Applications in Bangladesh (2000-2003), Climate Forecast Applications for Disaster Mitigation in Indonesia and the Philippines (2003-2008), Flood Forecast Technology for Disaster Preparedness in Bangladesh (2006-2009), and Flash Flood Forecast Technology for Disaster Preparedness in Bangladesh (2007-2009).

Activities/ expected deliverables 3.6-3.9 will be implemented/ achieved by relevant centres of the WMO's Global Data-Processing and Forecasting System and NMHSs through WMO coordination.

WMO has already established WMO global and regional structures, such as the Global Observing System (GOS), Global Telecommunication System (GTS), and Global Data-Processing and Forecasting System (GDPFS), concerning Numerical Weather Prediction (NWP) and marine forecasting, as well as regional frameworks by five tropical cyclone regional bodies, including the UNESCAP/WMO Typhoon Committee and WMO/UNESCAP Panel on Tropical Cyclones. In the north Indian Ocean region, WMO established the Regional Specialized Meteorological Centre (RSMC) New Delhi for regional warning services for tropical cyclones and associated storm surges, which supports activities of WMO/ESCAP Panel on Tropical Cyclones to mitigate tropical cyclone-related disasters.

A network of NMHSs of 189 WMO Members has 24/7 operational capability for observing and understanding weather and climate, and providing meteorological, hydrological and related services in support of relevant national needs, in particular for protection of life and property. NMHSs are responsible for issuing forecasts, advisories and warnings at national level, and RSMCs provide regional meteorological services for respective regions.

WMO assists in the enhancement of multi-hazard national warning mechanisms of NMHSs to support 24/7 dissemination of tsunami information and warnings, and to raise public awareness. Through various scientific and technical programmes, WMO facilitates collaboration between NMHSs and the international community, and furthers the application of meteorology for mitigation of the impacts of natural disasters and for public weather services, agriculture, aviation, shipping, fisheries, environment protection, and water resources.

**H. Contribution to regional coordination and/or cooperation towards the establishment and functioning of a regional early warning system for tsunamis and other hazards in the Indian Ocean and Southeast Asian region**

The project, in particular, methods and practices to reduce risks of tsunami, storm surges, large waves and other coastal hazards and build community resilience, and methods being demonstrated to sustain public and stakeholder interest in tsunami warning, contribute to the regional goals of the ICG/IOTWS Working Group 6 (refer to pp 3-26 to 3-27, Annex 4).

The project is linked to the project on End-to-End Early Warning of Tsunamis and Other Natural Hazards for Disaster Preparedness and Mitigation in the Indian Ocean and Southeast Asia: Phase 1 (EWS-1), implemented by ADPC and RIMES with funding support from the ESCAP Trust Fund for Tsunami, Disaster and Climate Preparedness under the first round of funding. While the EWS-1 focuses on establishing the regional data centre for tsunami warning and national adaptation of US-IOTWS tools in countries not targeted by the US-IOTWS programme, this project focuses on strengthening national, sub-national and local institutional systems and communities, for a truly end-to-end system that links global, regional, national, sub-national, and local institutions and communities.

The project will also support RIMES to provide research and development support to fill gaps in the regional and national systems for generation of warning information, and complement WMO regional operational arrangements for the provision of weather and related forecasting products by translating severe weather and related forecast research and development into improved operational regional forecast products. The project would enable a regional mechanism (eg: through WMO and RIMES) for continuous improvement of regional model performance and capacity building, for transferring those improvements to countries in the region.

Successful outcome of the project to improve operational forecasting for severe weather events for low-lying coastal areas, would spur regional cooperation to further improve these forecasts through improved observation systems and data sharing mechanisms.

These new-generation forecast information products could result in innovative applications to reduce risks in different national contexts and socio-economic circumstances, thus demanding a regional cooperation to ensure exchange of best practices. The project facilitates sharing of successful experiences from the region with the target countries.

## **I. Knowledge Management**

Section F includes the documentation of processes, experiences, lessons learned, and research outcomes, including periodic progress reports, for sharing with the Regional Steering Committee, ESCAP Trust Fund for Tsunami, Disaster and Climate Preparedness Advisory Council, UNESCO/IOC and ICG/IOTWS working groups, relevant publications and journals, national, regional and international forums, and the general public (through the RIMES website and quarterly newsletter). Under the bilateral agreements with participating countries, countries are to share the contributions of the project in appropriate external forums. Methodologies for collecting information would include taking note of first-hand experience, informal interview, seeking feedback from partners, and collecting newspaper clips.

## **J. Sustainability**

The project's major strategy is the demonstration of methods and tools and capacity building of institutions and stakeholders in using these methods and tools to facilitate adoption, sustain the initiatives, and replicate in other locations to upscale project impacts. As RIMES Professionals experienced in Bangladesh, Indonesia and the Philippines, through its climate forecast applications projects, government institutions invest in sustaining initiatives and in replication once public and economic benefits are demonstrated. Annex 9 features this experience and successes in the three countries. No major constraint to sustainability was encountered, due to the demand-based nature of the projects.

The second (final) regional sharing workshop will include sharing of institutional plans by the project countries to sustain the initiatives, taking advantage of, and incorporating elements from, the RIMES Master Plan.

The RIMES project staff, hired under the project, would continue beyond the duration of the project to assist these and other countries in similar activities, as per the RIMES Master Plan. The Master Plan incorporates project implementation, in not only the six target countries funded under this project, but also additional countries such as Kenya, Mozambique, Pakistan, Seychelles, Tanzania and Timor-Leste.

The additional skills and knowledge that the project would bring to the technical staff of the NMHSs and NDMOs of the target countries would be utilized by the staff in their day-to-day operational forecasting and management, respectively, as well as for forecasting and management of severe events.

The project recognizes that these skills would require periodic reinforcement. Hence, these capacities could also be made available regionally through RIMES, which could benefit from the involvement with WMO, so that these skills could be sustained through RIMES initiatives, such as through secondment arrangements, regional trainings, as well as through activities initiated under the RIMES Master Plan. Further, other initiatives from the RIMES Master Plan, focusing on coastal hazards, would enable opportunities for refreshment training, if so required, especially by low-capacity countries.

#### **K. Gender Issues**

In the entire end-to-end early warning chain, focussed attention will be given to factor-in gender-based differential vulnerabilities of women, elderly and vulnerable sections, and concrete actions will be embedded to address these differential vulnerability concerns.

Specifically, the composition of the early warning multi-stakeholder national forums through NGO and community representatives from select locations will represent all sections of the local society, including women, elderly, disabled and vulnerable sections. Public education and awareness-raising, and evaluation of the “last mile warning” will also incorporate gender dimensions.

Training and infrastructure, provided under the project, will also address the differential vulnerabilities to ensure appropriate response to emergencies. The training of disaster managers, including disaster management committees, at various levels in the translation of location-specific disaster risk information into impact outlook and preparation of response options will also focus on differential vulnerabilities and framing of appropriate response actions.

#### **L. How will the project address potentially adverse impacts?**

No adverse impacts on the target groups are foreseen.

#### **M. Partnerships**

RIMES and WMO are collaborating in the implementation of this project, each with the following roles:

RIMES:

- Technical inputs and guidance in the institutionalization and demonstration processes
- In-house research and development
- Grounding of TARNs in pilot communities
- Capacity building of disaster managers in vulnerable sectors, disaster management committees, community-based organizations, and pilot communities

WMO:

- Generation of downscaled disaster risk information
- Capacity building of NMHSs and other stakeholders including NDMOs, in applying weather, water and climate information for disaster risk reduction

WMO and RIMES have concluded a MoU for collaboration, and also a specific project implementation agreement with regard to implementation of this project. On behalf of RIMES and WMO, RIMES shall be the signatory for the project with UNESCAP.

Agreements exist through endorsement of RIMES Master Plan between RIMES and target countries, through their NMHSs and warning agencies: BMD (Bangladesh), IMD (India), DoM (Maldives), DMH (Myanmar), DoM and DMC (Sri Lanka), and TMD and NDWC (Thailand) to implement and reach the goals of the regional programme on End-to-End Early Warning of Tsunamis and other Natural Hazards for Disaster Preparedness and Mitigation in the Indian Ocean and Southeast Asia (refer to Annex 5 and Annex 11 RIMES Master Plan). The project contributes to Components 2 and 3 of the regional programme. These agencies are the project focal points in the countries, responsible for in-country project coordination with all stakeholders, implementation and monitoring of in-country activities at national, sub-national and local levels.

In each of the target countries, the project would coordinate with on-going or planned initiatives relating to early warning which could have either of the following two entry-points- i) national organizations (such as NMHS or NDMO); and, ii) local organization or communities. Coordination is achieved easily in the case of projects which are implemented through the NMHS or NDMO, as all local activities under this project in the target countries are led by them. Due cognizance of community level projects implemented by local organizations would be taken during the selection of pilot sites, leading to avoidance of overlaps and exploration of potential collaboration or synergy.

Information on ongoing and planned initiatives from donors and other organizations in the target countries could also be available to the project through the national forum, to be established by the project, which would include participation of all such national stakeholders. The national forums would also facilitate sharing of the project information and initiatives with all relevant stakeholders in each target country.

Specifically on Outcome 2: on connecting pilot communities to national early warning system for 24/7 readiness, this project would coordinate closely with UNDP (through regional and national offices), especially in India, where substantial efforts have been initiated (and are ongoing) relating to establishment of coastal early warning arrangements and local level emergency operation centres. The project would also ensure linkages and synergy with planned initiatives in all countries, especially in India at district/ state/ national levels.

All activity reports would also be made available to the wider audience in each target country through these national forums, as well as through implementation partners, such as NMHSs and NDMOs. Regular updates and achievements would also be reported in the updates, publications, and on the websites of the NMHSs, NDMOs as well as RIMES.

Project activities would also be discussed by the RIMES Council, comprising of not only the target countries, but several other countries from Asia and Africa. Regional workshop activities would also provide a forum for sharing of the knowledge and information generated from the project, with an even wider audience from across the world.

Specifically on Outcome 4: relating to generation of location-specific, downscaled hazard risk information, this project would dovetail with WMO's Severe Weather Forecasting Demonstration Project (SWFDP) for the Bay of Bengal, which has the goal – 'to improve the regional capacity for forecasting and delivery of warnings of hazardous weather conditions and weather-related hazards for enhancing the security of lives and livelihoods of coastal zone communities'.

All SWFDP projects would have a project management team, which includes every participating country (NMHSs are the lead). Training events include participation by the forecasting component, as well as user component(s). Inclusion of the latter with the forecasting components allows the development and delivery of warning services to meet the needs of the users/communities that need warnings. Further, information and knowledge generated from the project will flow in several ways: directly from forecasting units to operational users, while program information (e.g., regular project reports) will flow through various regional organizations (e.g., ESCAP Panel on Tropical Cyclones, Typhoon Committee RAI, WMO bodies, special regional bodies, among others).

Collaboration with the working groups of UNESCO/IOC ICG/IOTWS, in particular the Risk Assessment Working Group (WG3) and Modelling, Forecasting and Scenario Development Working Group (WG4), considering the convergence of tsunami wave run-up and inundation modelling and storm surge wave inundation for low lying coastal areas, would be facilitated. The collaboration will seek to further develop and utilize tools and model applications piloted by WG 3 and WG 4 relating to risk assessments and run-up modelling for the pilot sites, and share the experiences through the UNESCO/IOC ICG/IOTWS.

#### N. Counterpart contributions (in-kind and cash)

RIMES regional facility for research and development (Danida contribution):	580,000
RIMES Information Officer	12,480
RIMES Forecast Applications Scientist	99,840
RIMES Climate Scientist	39,000
RIMES Disaster Management Trainer	24,960
RIMES Project Coordinator	17,680
Curriculum Adaptation	65,000
Low-Cost Communication System	93,600
WMO Project Coordinator	33,800
WMO Scientists (experts on weather forecasting and public weather services)	121,680
Computing Facilities and Tools at WMO Members and Secretariat	300,000

**Total contribution:** **USD 1,388,040**

#### O. Monitoring, evaluation and audit

The project provides for in-house monitoring through a Project Coordinator, as well as an end of project review, along with an independent evaluation and audit, and budgeted as under Programme Management heading of the Activity Work plan. Each activity of the work plan identifies qualitative/quantitative indicators to aid the monitoring of the progress, which will be undertaken in collaboration with the relevant implementation partners in the field. An outcome and activity monitoring framework has been developed as below, which will aid regular monitoring. A monitoring and evaluation plan has also been detailed below, which will be followed.

Internally at RIMES, the Program Unit's Monitoring and Evaluation (M&E) Team will be updated on monthly basis of project implementation progress. Quarterly reviews by the M&E team, including the project implementation team, will assess progress against output and outcome indicators, identify constraints and problems met, and recommend adjustments/ actions to address these.

#### Outcome Monitoring

Outcome	Outcome Indicator(s)	Means of Verification*	By Who	By When**
1. Regular interactions of early warning institutions, disaster managers and communities through the biennial multi-stakeholder forums, regular user	At least 15 technical institutions, sectoral agencies, sub-national and local institutions and authorities, NGO and pilot community representatives participate in each national multi-stakeholder forums	Activity & progress reports; Forum participants' list	RIMES in collaboration with NMHSs/ NDMOs	12 months & 23 months

dialogues and early warning system checks at community level, and delivery, translation, communication and application of location-specific disaster risk information would keep community and stakeholder interests in tsunami warning and ensure that last mile communication systems are working.	NMHS and national warning agency visit pilot communities twice a year for a user dialogue, warning system evaluation (with particular focus on last mile communication), and awareness raising	Site visit reports; Progress reports	NMHSs/ NDMOs in collaboration with RIMES	12 months & 23 months
	At least 8 sub-national working groups are able to translate location-specific disaster risk information from NMHS into impact outlook and response options, and communicate these to local working groups	Activity & progress reports;	NMHSs/ NDMOs in collaboration with RIMES	23 months
	At least 8 local working groups communicate location-specific disaster risk information, impact outlook and response options to more than 80% of households in the pilot community	Site visit reports; Progress reports	NMHSs/ NDMOs in collaboration with RIMES	23 months
2. Early warning stakeholder institutions use the biennial multi-stakeholder forums to enhance inter-agency coordination, receive seasonal climate and hydrological outlooks for use in planning, provide feedback and identify actions to continuously improve tsunami, large waves, storm surges and other hazard warning	At least 10 national forum meetings received reports on actions taken by stakeholder institutions vis-à-vis recommendations and plan of action from previous forum	Activity & progress reports; Forum agenda, participants' list & report	RIMES in collaboration with NMHSs/ NDMOs	12 months & 23 months
3. Population at-risk use location-specific disaster risk information in decision-making to reduce disaster risks.	At least 8 communities provide feedback on receipt of information, actions taken, and recommendations for improvement	Site visit reports; Progress reports	NMHSs/ NDMOs in collaboration with RIMES	23 months

\* Mid-term and Final Evaluation reports would also provide additional means of verification

\*\* Duration after commencement of project

A. Activity	Indicator	Means of Verification*	By Who	By When**
<b>1. Strengthening institutional systems for end-to-end warning</b>				
Establish multi-stakeholder early warning national forums	A multi-stakeholder early warning national forum established in each target country	Activity & progress reports	RIMES in collaboration with NMHSs/ NDMOs	6 months
Provide technical inputs to biennial forums (national forums)	At least 6 multi-stakeholder national forums organized, with participation of and recommendations from local institutions and authorities, NGOs and representatives from select at-risk communities			12 months & 23 months
User dialogue and system evaluation at community level	At least twice a year visits made in each select community, and wider user feedback received			
<b>2. Connecting pilot communities to national early warning system for 24/7 readiness</b>				
Establish 24-hour warning points in selected communities	At least 12 warning points connected to the early warning system at sub-national and national levels	Activity & progress reports, Site	NMHSs/ NDMOs in collaboration	12 months

Establish, train and practice Emergency Operations Centres (EOCs)	At least 100 EOC volunteers trained in emergency operations	visits	with RIMES	23 months
Ensure effective warning communication pathways for selected communities	At least 3 communication pathways for receiving and disseminating warnings established at each EOC and tested			
<b>3. Capacity building for the application of warning information products</b>				
Constitute sub-national and local working groups	At least 12 sub-national and local working groups established	Activity & progress reports	RIMES in collaboration with NMHSs/ NDMOs	12 months
Training of local working groups in impact, vulnerability, coping strategy, user need assessments	At least 12 local working groups trained in impact, vulnerability, capacity and user need assessments			
Demonstration site selection and profiling	At least 12 demonstration locations with risk profiles prepared	Progress & site profiling reports, Site visits	NMHSs/ NDMOs in collaboration with RIMES	23 months
Determine thresholds for various hazard magnitudes and intensities	Thresholds for various hazard magnitudes and intensities in at least 12 sites identified	Activity & progress reports	RIMES in collaboration with NMHSs/ NDMOs	
User need assessment	Warning information needs in at least 12 communities identified	Activity & progress reports, Site visits		
Training of disaster managers in disaster risk information translation	At least 90 disaster managers trained in preparing impact outlooks and response options based on localized disaster risk information	Activity & progress reports		
Demonstration of location-specific disaster risk information in reducing disaster risks	At least 12 communities demonstrated improved response to warning/ disaster risk information issued by NMHSs	Activity & progress reports, Site visits		
Evaluation, research and tools development for systems improvement	Warning system gaps identified in at least 12 locations			
<b>4. Capacity building for the generation of location-specific warning information products</b>				
Analysis of available global NWP/EPS, and satellite-based products, including those for marine forecasting, and enhance capacity of a suitable WMO Regional Centre, to provide daily severe weather and related forecasting guidance	Most relevant NWP techniques and products identified and analyzed for further cascading forecasting process (at least from 3 global centers)	Activity & progress reports	WMO in collaboration with NMHSs & RIMES	12 months
Data and products assessment for generating location-specific disaster risk information products	Data and products assessed (at least from 3 centers) as inputs for downscaling and documented			
Evaluation of selected NWP/EPS, and satellite-based products, including those for marine forecasting, <i>and definition of the guidance products to be made available by the WMO Regional Centre, through the project</i>	Uncertainties in forecasting products (at least from 3 centers) evaluated and documented for local application			

Downscaling for high-resolution location-specific disaster risk information	Downscaled high-resolution disaster risk information generated (at least from 3 centers) and used by disaster management institutions in assessing potential impacts and possible response options			23 months
Training by secondment of NMHSs in generation of tailor-made location-specific disaster risk information	At least 2 NMHS scientists from each target country demonstrate ability to produce tailored location-specific disaster risk information			
<b>5. Regional sharing of experience, practice, lessons and successes</b>				
Annual regional sharing and learning workshop	At least 5 new countries participate each year, and share which tool, method, practice, etc. may be replicated	Progress & Workshop reports	RIMES	12 months & 24 months
Sharing project outcomes, experiences in ICG/IOWS meetings	6 country reports shared with ICG/IOTWS	Workshop reports		
Documentation and sharing in print, web media	At least 10 institutions informed of project progress, experiences and lessons	Website, media publications	RIMES, WMO	

\* Mid-term and Final Evaluation reports would also provide additional means of verification

\*\* Duration after commencement of project

As per monitoring and evaluation framework of the Fund, RIMES shall submit to ESCAP biannual progress reports, together with cumulative financial reports, by 31 May (covering the period to 30 April) and 30 November (covering the period to 31 October) each year within the duration of the project, following a progress reporting template provided by ESCAP.

An independent mid-term evaluation conducted around month 12 of the project and an independent end of term evaluation would be commissioned by RIMES. These evaluation reports will be conveyed to ESCAP within one month of their completion.

RIMES will arrange an independent audit of the project funds at the end of the project. RIMES would provide a terminal report within one month of the agreed project end date together with audits carried out under the project.

### Summary monitoring and evaluation plan

	Event	Description	Schedule
1	Field implementation monitoring	Ongoing monitoring of implementation by implementing partners, including field verification, review of progress reporting, and analysis of financial expenditure.	Ongoing/continuous
2	Quarterly reviews	Assessment by RIMES Monitoring and Evaluation Team to review progress, and identify and address issues	Quarterly, with monthly progress updates
3	Biannual reviews / progress reports	Joint assessment of RIMES and WMO to review progress, address issues, and provide program guidance.	Bi-annual
4	Mid-Term Evaluation	Mid-term evaluation to assess progress towards program results, articulated in the Results Framework, and provide recommendations.	50% programme completion
5	Final Programme Evaluation	Final programme evaluation to assess achievement of programme results articulated in the Results Framework and document lessons learned.	100% programme completion

It should be noted that, RIMES has an institutional system for audit.

'Extract from RIMES International Cooperation Agreement'

**Article 21. Audit**

*Accounts of all revenues and expenditures shown in the budget, and the balance sheet of assets and liabilities of the Regional Integrated Multi-Hazard Early Warning System for Afro-Asian Region shall, under the conditions laid down in the financial regulations, be submitted for independent audit to establish that all revenues have been received, and all expenditures are incurred in a lawful and regular manner, and that the financial management of the Regional Integrated Multi-Hazard Early Warning System for Afro-Asian Region has been sound. The auditors shall submit a report on the annual accounts to the Council.*

'Extract from RIMES Financial Regulations'

**Article 3. Appointment of Auditors**

- 3.1 Auditing of accounts provided for in Articles 10(C) and 21 of the Agreement shall be carried out by the auditors under the conditions laid down in these Financial Regulations.
- 3.2 The Council, acting in accordance with Article 21 of the Agreement, shall appoint two auditors, or one Audit Board. For this purpose, the Secretariat shall draw up a list of candidates.
- 3.3 In case of appointment of individually nominated auditors, a deputy to each auditor from the same Member State shall also be appointed.
- 3.4 Each auditor shall be appointed for a period of four years. Initially, the term of office of one of the auditors shall expire after two years, and the auditors will subsequently be appointed alternately once every two years.
- 3.5 The four-year term of office is considered to apply to the duration of all operations relating to four financial years.
- 3.6 The auditors will work as a board of two. An auditor may be replaced by a deputy, on condition that the latter shall serve as a substitute only and shall not accompany the auditor during audits.
- 3.7 Travelling and subsistence expenses only shall be paid by RIMES to the auditors or, where appropriate, to their deputies, in accordance with the Staff Regulations of RIMES. In determining the allowance payable for travel and subsistence, the auditor and his/her deputy shall be treated as members of the staff, as defined in the Common Travel Regulations.
- 3.8 The auditors may be invited by the Chairman of the Council and the Chair of the Secretariat to attend meetings of the Council and the Secretariat, which are devoted to examining their report.

**P. First Payment**

An initial payment of US\$ 761,008 will be provided by ESCAP upon signature of the Agreement by both to start the activities 1.1, 1.2, 1.3, 2.1, 2.3, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 4.1, 4.2, 4.3, 4.4, 6.1 as indicated in the attached Activity Work Plan (Annex Q).

Subsequent payments will be provided upon approval by ESCAP of a written request for payment from RIMES, together with the relevant progress reports containing both substantive and financial sections, and will take into account the progress of the project and projected liquidity needs, as contained in the Activity Work Plan (Section Q).