

## CREWS pipeline countries – status as of June 2020

1. The Steering Committee regularly identifies Least Developed Countries (LDCs) and Small Island Developing States (SIDS) to be included in a pipeline list. Countries and regions are included in the pipeline list if they demonstrate a sufficient level of eligibility, ownership and readiness for the preparation of project proposals for potential future funding decisions.
2. There are currently 76 Least Developed Countries (LDCs) and Small Island Developing States (SIDS)<sup>1</sup>. To assist the Steering Committee in its decision making, the CREWS Secretariat compiles information on early warning systems for all LDCs and SIDS, in an ongoing manner, using three criteria reflecting need, demand and leveraging potential. Details of the three criteria for which information is compiled are found in Annex 1 to this document.
3. To further assist the Steering Committee prioritize its financing decisions, short briefs are prepared for each country/region included in the pipeline list, with information on the risk and capacity, priority needs, overall budget and timeframe. The current list of CREWS pipeline countries, as of June 2020, is found in Annex 2 to this document.
4. The briefs for each pipeline country/region are in Annex 3. Please note that the brief for Cambodia and Lao PDR has recently been added and that the brief for the South-West Indian Ocean has been revised to include Mozambique and Tanzania, in addition to Comoros, Madagascar, Mauritius and Seychelles. Both these briefs are highlighted.

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<sup>1</sup>Source: United Nations/DESA, as of May 2020. There are 38 SIDS and 47 LDCs with 9 countries that are both an LDC and SIDS. The African continent accounts for 33 LDCs and 5 SIDS.

## **ANNEX 1 – Criteria for which information is compiled on early warning for LDCs and SIDS.**

You can access a table with data for the below criteria at <https://www.crews-initiative.org/en/impacts> under Effectiveness of CREWS Investment/Mapping.

- a. Exposure to risk and institutional capacity for early warning – need
  - i. Capacity of NMHSs and disaster management institutions
  - ii. Projected average annual loss to disaster (projected cost of disasters for the country's economy per year)
  - iii. Casualty loss risk (where available)
  - iv. Access and penetration of information and communication technology
- b. Level of priority given to early warning systems by countries – demand
  - i. Requests for support by country
  - ii. Identification of early warning systems as a priority in Nationally Determined Contributions (NDCs) and national development and poverty reduction plans
- c. Potential for leveraging additional resources and aligning programmes – leveraging
  - i. Potential to leverage investments from other mechanisms such as the Green Climate Fund (GCF), the World Bank Group's International Development Association (IDA), the Global Environment Fund (GEF) and other financing mechanism
  - ii. Ongoing or planned national and regional programmes related to the objectives of CREWS

## ANNEX 2 - CREWS Pipeline countries

Country/Region (in alphabetic order)	Indicative portfolio in US\$ million	Short description
<b>1. Benin</b>	3.0	Benin needs to modernize its hydromet and climate service system and to continue building resilience to disaster and climate-related risks through: (i) enhancing provision of reliable and accessible weather and climate services; (ii) expanding hydro-meteorological services; (iii) tailoring hydromet information packages to decision makers; (iv) strengthening institutional arrangements and standard operating procedures; (v) establishing a legal framework to improve coverage of EWS; (v) supporting gender-mainstreaming in IDA-funded Hydromet project.
<b>2. Bhutan</b>	3.5	Bhutan will prioritize establishing end-to-end EWS in key flood affected dzongkhags in an inclusive and gender-sensitive way. Support will also be provided to strengthen capacity of key stakeholder agencies, enhance interoperability of its monitoring systems, improve forecasting capacity and flood risk knowledge, and ensure dissemination and communication to affected Dzongkhags and Geogs.
<b>3. Cambodia and Lao PDR (sub-regional)</b>	5.5	Cambodia and Lao PDR aim to strengthen hydromet and early warning services, as well as preparedness, early action and response by disaster management offices to hazardous hydromet events such as droughts and others that lead to disasters such as the 2018 dam collapse in Lao PDR, which was cause by immediate flash flooding in the region, and also impacted the Northern part of Cambodia.
<b>4. Curacao (St Maarten and Aruba)</b>	1.6	Curacao will aim to improve EWS including: Flash Flood Guidance System, Coastal Inundation forecasting, project development, product generator and automated dissemination generator.
<b>5. Ethiopia</b>	3.0	Ethiopia will support institutional capacity building, development of the concept of operations and service delivery strategy, identification, development and operationalization of priority services, strengthen the communication link between the providers and the local users, enhancement of the capacity of users to understand and utilize climate and hydrological information products in a gender-inclusive manner and the use of hydromet early warning information for decision making at different levels.
<b>6. Madagascar</b>	3.0	This project will address the limitations of hydrometeorological services through an integrated approach of technical assistance and investments in equipment. CREWS support will be fundamental in starting to address the technical and institutional capacity priorities. In parallel, national and regional IDA as well as GCF funding would be sought to address investment needs in observation and monitoring equipment.
<b>7. Mozambique</b>	2.0	This project will support the implementation of a Government disaster risk management program, specifically contributing to a component on local DRM committees and early warning systems and would directly leverage the USD 10 million that is budgeted for those components.
<b>8. South-West Indian Ocean (Comoros,</b>	4.0	The project objective, in line with an AFD-funded investment, is to enhance the adaptive capacity and climate resilience of communities and economic sectors in six countries of the SWIO region. This would

<b>Madagascar, Mauritius, Seychelles, Mozambique, United Republic of Tanzania)</b>		involve strengthening multi-hazard and impact-based early warning systems through: (i) improving the regional cooperation frameworks for operational forecasting of tropical cyclones, storm surges, other severe weather events, flooding and climate extremes; and (ii) supporting dissemination, emergency planning and response capacities in each of the beneficiary countries.
<b>Total:</b>	<b>25.6</b>	

### ANNEX 3 – CREWS Pipeline Countries/Regions Briefs

Country/Region	Benin							
Profile	Level of Disaster Risk	Medium <sup>1</sup>	Average annual loss to disasters	Data not fully available.	Access to information & communications (ICT index)	Ranked 161th in the ITU's ICT Development Index 2017 <sup>2</sup>	Capacity of NMHS	Moderate
	Status of hydromet and EWS	Moderate	Disaster loss and risk data to inform early warning	Data not fully available.	Demand/Priority	High	Leveraging potential	High Potential IDA operation is planned.
Context	<p>Floods and droughts are the most important and recurring adverse natural events in Benin. Benin would be significantly affected by climate change: medium-term climate projections indicate the rise of climate-related risks due to increasing temperatures, insufficient levels of rain, increased evapotranspiration and increased rainfall variability. Droughts are likely to become more frequent and intensive and could affect the ability of already stressed land and water resources to provide a secure stream of ecosystem services necessary for poverty alleviation. In Benin, half the country's population (over 3 million inhabitants) lives on the coastal areas and most of them in the city of Cotonou, in the Gulf of Guinea. The coastal region is vulnerable to sea-level rise, which could potentially have catastrophic impacts on the economy, the population and natural systems. Coastal erosion and the sea level rise exacerbated by human activity have medium- and long-term consequences that are already threatening vulnerable communities and disrupting the least-protected and sensitive ecosystems<sup>3</sup>. These could include changes in the length and duration of the growing season, and changes in crop quality and yields having negative effects in agricultural production (around 25% of GDP).</p> <p>In 2010, Benin faced one of the most destructive floods in its history. Over 680,000 people were affected and 46 people lost their lives. Areas that were not considered flood prone were devastated with entire villages being wiped out and damages totaled up to US\$260 million (around 4% of GDP). The World Bank provided financial support from the Global Facility for Disaster Reduction and Recovery (GFDRR) to carry out the Post Disaster Needs Assessment (PDNA). Following the floods, the Government of Benin decided to undertake a</p>							

<sup>1</sup> INFORM, index for risk management (2018), Benin ranks 74th

<sup>2</sup> <http://www.itu.int/net4/ITU-D/idi/2017/>

<sup>3</sup> Climate Change Adaptation, UNDP

	<p>comprehensive assessment to identify the structural causes of the disaster, and to develop medium and long-term strategy to reduce the flood risk in the country. A key finding of the assessment was that the existing disaster response communication system was insufficient to reach the large portion of the population. The GoB undertook a detailed assessment of the alerts communications chain and protocols, identifying roles and responsibilities, as well as defining how early warning messages should be more effectively shared<sup>4</sup>. Based on this assessment and with the support of United Nations Development Program (UNDP) and the Global Environmental Fund (GEF) for a total of USD\$18 million, the first Early Warning System in the country was officially launched on January 15th, 2013. Twenty meteorological stations and three oceanographic stations were installed and implemented; a standard communication operating procedure was completed; trainings were provided to main stakeholders working at the national and departmental levels; five visualization platforms were installed among other achievements. The country issued early warnings for flood events through a multi-agency committee in 2014 and 2015. The country has adopted a Standard Operating Procedure for the diffusion of alerts through the National Disaster Management Agency. The lessons learned of these projects could serve as a starting point to continue the strengthening of the EWS in Benin. Benin has started to build the technical and institutional frameworks to reduce the impact of climate-related events in the country. A potential IDA-funded project will support the country in consolidating these efforts and increasing the capacity of the country to produce, manage and build reliable hydro- meteorological services. CREWS would allow the Bank to provide continuous technical assistance and advice for the implementation of the potential IDA-funded project for advancing the modernization of hydromet and climate services and early warning systems.</p>
<p><b>Priority Needs</b></p>	<p>Benin’s priority needs are focused on strengthening and modernizing its hydro-meteorological and climate services system in terms of basic infrastructure and network for monitoring and forecast and improve climate services with reliable information. For this, the country needs to enhance technical capacity to manage, operate and maintain the Hydromet network and expand their early alert system. The country has had little success to date in successfully packaging relevant information to end-users including the private sector. The country has also gaps in their legal framework to expand the coverage of its early warning system.</p> <p>To help the country modernize its Hydromet and climate service system and continue building resilience to disaster and climate- related risks, the following needs have been identified:</p> <ul style="list-style-type: none"> <li>- Enhancing provision of reliable and accessible weather and climate services based on better Hydromet data, knowledge and tools;</li> <li>- Expanding hydro-meteorological services, both for early warning systems tied to food security, but also to complement agricultural extensions and production services;</li> <li>- Tailoring Hydromet information packages to decision makers across a wider series of sectors, such as health, energy and water resources management;</li> <li>- Increasing productivity and improved drought resilience of the agricultural sector through the provision of better agro- meteorological</li> </ul>

<sup>4</sup> ReliefWeb, Establishing Emergency Flood Warnings in Benin, (2016)

	<p>information and services;</p> <ul style="list-style-type: none"> <li>- Strengthening institutional arrangements and standard operating procedures for the expansion of EWS of weather and climate-related hazards;</li> <li>- Establish a legal framework to improve coverage of EWS including the private sector telecommunications providers and broadcasters; and,</li> <li>- Support of gender mainstreaming in IDA-funded Hydromet project particularly through the dissemination of the Hydromet information in gender sensitive, informed and open way and the inclusion of women in all aspects of activity implementation and dissemination of EWS information (SCD refers to this as gender-responsive disaster preparedness efforts)</li> </ul>
<b>Overall Budget</b>	<b>US\$ 3.0 million</b>
<b>Timeframe</b>	<b>3 years</b>
<b>Partners</b>	<b>World Bank, WMO</b>

<b>Country/Region</b>	<b>Bhutan</b>							
<b>Profile</b>	<b>Level of Disaster Risk</b>	High <sup>5</sup>	<b>Average annual loss to disasters</b>	Limited information on disaster losses. Estimate of losses due to natural disasters – \$12m (8 yr mov. Avg. 2005-13). Extreme events such as cyclone Aila or GLOF have significant damages on economy.	<b>Access to information &amp; communications (ICT index)</b>	Ranked 121th in the ITU's ICT Development Index 2017 <sup>6</sup>	<b>Capacity of NMHS</b>	Low

<sup>5</sup> GFDRR and World Bank (2017), Disaster Risk Profile, Bhutan

<sup>6</sup> <http://www.itu.int/net4/ITU-D/idi/2017/>

	<b>Status of hydromet and EWS</b>	Very basic <sup>7</sup>	<b>Disaster loss and risk data to inform early warning</b>	Highly Limited <sup>8</sup>	<b>Demand/Priority</b>	High	<b>Leveraging potential</b>	Medium-High
<b>Context</b>	<p>Bhutan is a small landlocked country nestled in the eastern Himalayas between China and India with the population slightly over 808,000 in 2017. Bhutan is highly vulnerable due to its fragile geological conditions, vulnerable ecosystems, and climatic conditions. Hydro-meteorological disasters are frequent and include riverine and flash flooding, landslides, Glacier Lake Outburst Floods (GLOF), cloudbursts, windstorms, and river erosion. The country ranks fourth highest in the Asia-Pacific region in terms of relative exposure to flood risk as a percentage of population, with 1.7% of its total population exposed to such risks (UNESCAP and UNISDR 2010). It has been afflicted by several significant disasters such as the 1994 Glacier Lake Outburst Flood, windstorms in 2011 and 2013, and the 2009 cyclone Aila. The combination of the 2009 earthquake and cyclone Alia cost 5.7% of its GDP. This is in addition to the chronic losses faced from landslides and flooding every monsoon. Between 1994 and 2011, some 87,000 people were affected and over 380 deaths occurred due to natural disasters in Bhutan (floods, windstorms, earthquakes, and GLOFs).</p> <p>With climate change, the frequency and intensity of extreme weather-related events are expected to increase; it is observed that cyclone-induced heavy rains and flash-floods, windstorms and hailstorms are becoming much more frequent. These negatively impact food security/food self-sufficiency, damaging scarce 2.75% of cultivable farm land, and threaten downstream critical infrastructure, human settlements, while destabilizing bio-diverse ecosystems. Damaged farm roads and national highways repeatedly cut-off vital transport routes between the highlands, inner central valleys, and southern townships adversely impacting food supplies, access to vital health and energy services and economic development. The Royal Government of Bhutan (RGOB) is a global standout in this dialogue; acting as a net sink for Greenhouse gases (GHGs) and as a Nationally Determined Contribution (NDC) that is tagged as being one of the most ambitious. Bhutan is embarking on its 12th Five Year Plan with a strong focus on climate resilience.</p> <p>A Roadmap for Modernizing Weather Water and Climate Services in Bhutan was developed in 2015 with close collaboration between the World Bank and RGOB. In 2016, the Bhutan Hydromet Services and Disaster Resilience Regional Project (HDSRRP) was approved by the World Bank, providing grant funding (from SAWI and GFDRR). One of the three implementing agencies receiving support from this project in the amount of US\$1.6 million is the National Center for Hydrology and Meteorology (NCHM) (formerly the Department of Hydromet Services, DHS). The objective of the project is to strengthen Bhutan’s capacity for hydromet services and disaster</p>							

<sup>7</sup> Modernizing Weather, Water, and Climate Services : A Road Map for Bhutan -<https://openknowledge.worldbank.org/handle/10986/22480>

<sup>8</sup> [https://www.climateinvestmentfunds.org/sites/default/files/meeting-documents/ppcr\\_21\\_4\\_strategic\\_program\\_for\\_climate\\_resilience\\_for\\_bhutan\\_final.pdf](https://www.climateinvestmentfunds.org/sites/default/files/meeting-documents/ppcr_21_4_strategic_program_for_climate_resilience_for_bhutan_final.pdf)



	<p>preparedness, with outcomes related to strengthening the provision of hydromet services, both public weather services and early warning as well as sector related services, such as to civil aviation and agriculture. As NCHM is transitioning into an autonomous center, it is developing a strategic plan for hydromet modernization. CREWS support will build on this initial phase and also contribute to the implementation of RGOB’s strategic plan while operationalizing the investments made (through the HDSRRP) to establish a National Emergency Operational Centre.</p>
<b>Priority Needs</b>	<p>RGOB is in the initial phase of modernizing its hydromet observation systems based on the Roadmap developed (noted above) and while there have been some prior investments with support from development partners in GLOF Risk assessments and Early Warning, there is insufficient support to flood EWS. Priorities include establishing end-to-end EWS in key flood affected dzongkhags in an inclusive and gender sensitive way.</p> <p>This includes improvements of basic weather forecasting and hydrological and flood forecasting, enhanced quality, availability, and transfer of real time climate data in all Dzongkhags, strengthening of hazard and risk assessments, and improving collaboration between the National Center for Hydrology and Meteorology (NCHM), Department of Disaster Management (DDM), Department of Geology and Mines (DGM) and the Flood Engineering and Management division (FEMD) to develop and update vulnerability mapping, improve communication of warnings to communities, and strengthen communities’ capacity to respond to warnings in a gender inclusive manner.</p> <p>In addition, a key issue that is affecting NCHM’s ability to deliver EW and climate services has been its reliance on grant funding from many different sources that has resulted in multiple systems and models with little interoperability and its low capacity in managing its systems. Through CREWS support, end-to-end EWS would be piloted in selected hotspot areas that could be scaled up with leveraged funding from other sources (WB, JICA, GCF etc.).</p> <p>Support would be provided to strengthen capacity of the key stakeholder agencies (NCHM, DDM and FEMD), enhance interoperability of its monitoring systems, improve forecasting capacity and flood risk knowledge, and ensure dissemination and communication to affected Dzonkhags and Geogs, through the NEOC, DEOCs and other channels.</p>
<b>Overall Budget</b>	<b>3.5 M USD</b>
<b>Timeframe</b>	<b>4 years</b>
<b>Partners</b>	<b>World Bank, WMO</b>

<b>Country/ Region</b>	<b>Cambodia and Lao People’s Democratic Republic (Lao PDR)</b>	
<b>LDC or SIDS Profile</b>	<b>Level of Disaster</b>	Cambodia and Lao PDR are highly vulnerable to the impacts of natural hazards. Hydrometeorological hazards,

	<b>Risk</b>	such as strong winds, floods, droughts, or storm surges and those triggered by these hazards (such as landslides), pose a direct threat to lives and impact livelihoods by damaging and destroying infrastructure, assets, and land. In recent years, a succession of tropical cyclones/typhoons, floods, and droughts has resulted in major loss of lives, livelihoods, and economic assets in both countries. Lao PDR experienced major typhoons in 2009 (Ketsana) and in 2011 (Haima), and in 2013 when floods caused damages of over US\$270 million. In 2018, Lao PDR experienced its most devastating floods in a decade, with estimated damage and losses worth US\$371.5 million, or 2.1 percent of Lao PDR's projected Gross Domestic Product (GDP) for 2018 <sup>9</sup> . In Cambodia, Typhoon Ketsana in 2009 and floods in 2011 and 2014 caused damages and losses totaling over US\$1.1 billion. In Cambodia, the strongest El Niño episode of the past 50 years in 2015/2016, resulted in 2.5 million people being affected by droughts, water shortages, land degradation, livestock loss and reduced agricultural productivity. <sup>2</sup> In Lao PDR, rain-fed rice cultivation constitutes more than 90 percent of the rice growing area in the country, whereas only about 6 percent of rice growing areas have access to irrigation facilities. Drought occurrence therefore has a significant impact on the total annual rice production of smallholder farmers. <sup>3</sup> Cambodia and Lao PDR rank first and second in the sub-regional risk rank with 5.5% and 5.4% agriculture droughts AAL (average annual losses) as a proportion of their GDPs. Considering the agricultural sector's contribution to livelihoods and food security in both countries, the expected increased economic impacts of more intense and frequent agricultural droughts, will translate into significant human impacts.
	<b>Status of hydromet and EWS</b>	Cambodia and Lao PDR have national meteorological and hydrological systems that can provide a basic level of services but fall behind other countries in the region in terms of core capacities, forecasting technology, development and delivery of value added services, and research and development. Hydromet services and agencies operating EWS systems in both countries are also constrained by limited financial, physical, and human resources. In addition, national investments in hydromet (National Meteorological and Hydrological Services, NMHSs) and Early Warning Systems (EWS) are often provided through bilateral support and focus on separate elements of hydromet infrastructure. There is a lack of compatibility and interoperability among the separate systems. Sustainability of operations, maintenance of facilities and equipment remain a challenge in the context of significant reliance on project-based donor investments. Regional initiatives such as the Southeast Asia Severe Weather Forecasting Project (SeA SWFP) and the Southeast Asia Flash Flood Guidance System (SeAFFGS), are working towards harmonizing forecasting of severe weather and advise on the potential of flash flood threats in the region. In this regard, the Regional Forecasting Support Centre (RFSC), Ha Noi, provides support to countries in the region by analyzing and interpreting information received from global centres (who provide Numerical Weather Predictions), to prepare daily guidance products for NMHSs' in the region. The Department of

<sup>9</sup> Government of Lao PDR. 2018. Post Disaster Needs Assessment, 2018 floods.

		<p>Meteorology, Cambodia (DOM) and the Department of Meteorology and Hydrology, Lao PDR (DMH) have access to all products and maintain responsibility and authority over national warnings and services; to issue alerts, advisories, severe weather warnings.</p> <p><b>In Cambodia</b>, DOM is under the Ministry of Water Resources and Meteorology (MOWRAM), and the Department of Hydrology and River Works have limited technical expertise, human resources and financial resources. In recent years, observation networks, production system, and financial sources have been improved, with DOM undergoing a comprehensive modernization effort. The Mekong River Commission (MRC) supported the installation of 12 hydrological stations; The Asian Development Bank (ADB) also financed the establishment of the National Flood Forecasting System and capacity technical assistance. The World Bank has also supported a series of regional Mekong Integrated Water Management Projects to strengthen the capacity of governments in Cambodia, Lao PDR, and Vietnam on hydromet network modernization. Nonetheless, staffing, systems, and financing are still inadequate to ensure weather, climate, and hydrological information and services. There is also a lack of interaction between meteorological and hydrological departments<sup>10</sup>. In regards to risk knowledge, while the country maintains a DesInventar-based national disaster loss database with records since 1996 key challenges refer: to institutionalization of post-disaster assessment and data collection; consistency in sex, age and disability disaggregation; absence of national standards for disaster information. Application of risk information is constrained by the lack of standards on hazard, vulnerability and risk assessments and absence of a dynamic risk assessment platform.</p> <p><b>In Lao PDR</b>, DMH which is under the Ministry of Natural Resources and Environment (MONRE) is responsible for hydromet and early warning systems. The World Bank's series of regional Mekong Integrated Water Resources Management Project to promote IWRM, and the ongoing Lao PDR Southeast Asia Disaster Risk Management focuses on strengthening early warning systems and modernizing hydromet systems. ADB, FAO, UNDP JICA have also supported hydromet strengthening – these interventions are largely sector specific (FAO focuses on agricultural meteorology), focus on last mile connectivity (FAO, UNDP), or small-scale technical assistance (ADB), rather than systemic changes to the national system. In addition, the systems supported by bilateral partners are largely separate and not integrated. In Lao PDR, drought management strategies are not well established and rural population rarely get warning information for early action. Lao PDR currently has in place only emergency and recovery strategies that regulate disaster response after droughts have taken place<sup>11</sup>.</p>
<b>Context</b>	As highlighted in a World Bank and GFDRR policy note on “Strengthening the Regional Dimension of Hydromet Services in Southeast Asia”, published in 2018, there are benefits to a more regional approach to monitoring and forecasting hazardous hydromet events.	

<sup>10</sup> World Bank. 2018. Strengthening the Regional Dimension of Hydromet Services in Southeast Asia.

<sup>11</sup> FAO, APDC. (Forthcoming): Developing a Regional Drought Risk Management Programme in Greater Mekong Sub-region

	<p>Existing regional frameworks and initiatives in the region are leveraged to address major challenges that national hydrometeorological service providers face. In addition to efficiency gains in coordinating requirements and collective needs, such as savings on the cost of capital infrastructure as well as sustainable operation and maintenance, a more regional approach across Cambodia and Lao PDR would allow for better sharing of data, expertise, and experiences. Therefore, it is important that the project builds on activities and achievements of ongoing and previously completed projects (DeRisk SeA, Canada CREWS SIDS SeA, Lao PDR Southeast Asia Disaster Risk Management Project, among others) that have strengthened the regional dimension, by building resilience to high-impact hydro-meteorological events through the strengthening of multi-hazard early warning systems. International good practice suggests that a regional approach applied to countries facing common hydromet conditions (like Cambodia and Lao PDR,) has advantages: it enables enhanced networking; ensures robust interoperability, efficiencies, and optimization of infrastructure costs; and results in greater harmonization, integration, and complementarity within the region.</p>
<p><b>Priority Needs</b></p>	<p>This project aims to strengthen hydromet and early warning services, as well as preparedness, early action and response by disaster management offices to hazardous hydromet events such as droughts and others that lead to disasters such as the 2018 dam collapse in Lao PDR, which was caused by immediate flash flooding in the region, and also impacted the Northern part of Cambodia. As weather, climate, and water know no national borders, there is a need for countries to adopt effective regional collaboration that can contribute to improved forecast accuracy, boosting the capabilities of NMHSs, leading to increased savings and sustainability of investments in the longer term. Support from regional and global centers will be critical in realizing the outcomes within the project. For instance, the RFSC Ha Noi, Vietnam can aid with enhancing capacities of the NMHSs to forecast severe weather and build upon the implementation of a Flash Flood Guidance System in the subregion (Cambodia, Lao PDR, Thailand and Vietnam) and support from the Centre for Climate Research, Singapore can be used to develop consensus-based on seasonal to sub-seasonal forecasts on a sub-regional scale. Project outcomes include increased institutional capacities of National Meteorological and Hydrological Services and the Disaster Risk Management entities of Cambodia and Lao PDR in generating, communicating, understanding and responding to impact based warnings. A major outcome is minimizing damage, disruption to services, economic losses and human development impacts in Cambodia and Lao PDR from hydrometeorological hazards, especially those of a cross-boundary nature. Additionally, it can improve harmonization, compatibility, and integration of systems and lead to establishment of formal cooperation with regional centers for capacity building. The project will address the following priority needs, which fall under the following Outcomes:</p> <p><b>Outcome 1 :</b> Strengthened institutional capacities and enabling environment created  The main objective of this outcome is to establish where required and reinforce coordination mechanisms between relevant stakeholders at the national level to create an enabling environment for improved weather, water and climate services. It also aims to improve disaster risk reduction, preparedness and response plans that incorporate and elaborate on roles and responsibilities of relevant actors for enhanced last-mile communication and strengthened Early Warning -Early Action chain.</p> <p>Broad Activities include:</p> <ul style="list-style-type: none"> <li>• Development and/or update of existing Met Bills, which when endorsed and enacted by national parliaments and assembly, will</li> </ul>

	<p>provide legally mandatory functions;</p> <ul style="list-style-type: none"> <li>• Development and/or update of National Strategic Plans (NSP) and establishment of the National Framework for Weather and Climate Services and the respective Action Plan for the modernization of their services to meet user needs, through a User Interface Platform expected to facilitate sustained national dialogue;</li> <li>• Establishment of a coordination mechanism between relevant stakeholders in integrated water resource management at transboundary level, including the development of a strategy and tool for operational purposes;</li> <li>• Review of National and sub-national Disaster risk reduction strategies or integrated DRR and CCA strategies/plans; disaster risk reduction implementation plans; preparedness and response plans to strengthen EWS governance frameworks by elaborating on roles and responsibilities for enhanced multi-hazard Early Warning capacities and Early action;</li> <li>• Development of needs assessments to identify investments for strengthening national network architecture, along with requisite investment plans and bidding documents, to ensure continued engagement in the hydromet sector.</li> </ul> <p><b>Outcome 2:</b> Quality of forecasts and warning improved The objective of this outcome is to improve the quality of the regional and national products as well the capacity of forecasters to use these refined products that will address service delivery gaps as well as human and infrastructural challenges while also developing or strengthening risk information to guide early warning systems and climate services which will be made more accessible and usable to the relevant stakeholders.</p> <p>Broad Activities include:</p> <ul style="list-style-type: none"> <li>• Leveraging support through accredited and established regional centers to improve access to hydromet forecast information through existing initiatives such as Severe Weather Forecasting Project (SWFP) and Flash Flood Guidance System) and to enhance capacities in the region on climate data management and reinforce climate service delivery through the Regional Climate Outlook Forum (RCOF);</li> <li>• Enhancing capacities to generate, manage, share and apply risk knowledge (disaster information as well as risk profiling, including vulnerability assessments); and</li> <li>• Developing and implementing an integrated platform for flood and drought monitoring along with the establishment of National drought monitoring and forecasting mechanisms including meteorological, hydrological and agriculture indicators in line with the 2020 – 2025 Drought management strategy for Lower Mekong Basin.</li> </ul> <p><b>Outcome 3:</b> Information and communication technology strengthened This outcome aims to enhance NMHSs’ IT capacity to access, exchange and deliver meteorological, hydrological, and other related environmental information and services.</p> <p>Broad activities under this specific outcome include:</p> <ul style="list-style-type: none"> <li>• Improved internet capacities and access to a dedicated web/cloud service; • Increased number of and improvements to existing servers (or cloud services - web platforms) and workstations to host and operate/contribute to the Service Delivery Platform; and</li> </ul>
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	<ul style="list-style-type: none"> <li>• Development of a publicly accessible web platform to inform the population, public authorities, civil security services and health authorities of potentially dangerous meteorological events. Additionally, support will be provided so that institutions are able to share and display accessible weather and flood warnings from Cambodia and Lao PDR for at least 48 hours, in a manner that is understandable for professionals and the public, in particular more vulnerable populations using a dedicated web platform and mobile application potentially expandable to cover other relevant hazards and allow dynamic risk mapping and assessment.</li> </ul> <p><b>Outcome 4:</b> Service Delivery Enhanced and capacities for early action strengthened The objective of this outcome is to improve in-country response to multi-risk information and warnings through increased coordination between NMHSs and DRM authorities, and other relevant authorities at the sub-regional, national and provincial level and move towards translating and communicating hydromet impact-based warnings to vulnerable communities and enable early action measures.</p> <p>Broad activities include:</p> <ul style="list-style-type: none"> <li>• Harmonization of warning criteria for hydromet hazards, given their cross-boundary nature in SEA region to improve data sharing and enable sub-regional cooperation for climate and disaster risk management;</li> <li>• Enhancing capacities of sector government entities (agriculture, water resources, health, disaster management, social protection, etc.) in the region for drought adaptation and mitigation;</li> <li>• Enhancing capacities for Early action and rollout ASEAN disaster responsive social-protection guidelines;</li> <li>• Development and/or improvement in existing Service Delivery Mechanisms with the target products for EWS inclusive of DRM;</li> <li>• Pilot testing existing IBFWS (if possible, by focusing on cross-boundary pilot areas) using Community Based Flood Management (CBFM) practices adopted from the Associated Programme on Flood Management (APFM) programme; and</li> <li>• Conducting assessments of risk communication, local and indigenous knowledge integration and last-mile connectivity of MHEWS in the region to support national/local EWS strategies' enhancement Overall, identify and address challenges to strengthen early warning dissemination channels and improve end users' response by exploring engagement with the private sector and civil society organizations, women's groups and person with disability, school community, health authorities, farmers' organizations, infrastructures' constructors and operators (e.g. dams operators) potentially in the same cross-boundary pilot areas as above.</li> </ul> <p><b>Outcome 4:</b> Service Delivery Enhanced and capacities for early action strengthened The objective of this outcome is to improve in-country response to multi-risk information and warnings through increased coordination between NMHSs and DRM authorities, and other relevant authorities at the sub-regional, national and provincial level and move towards translating and communicating hydromet impact-based warnings to vulnerable communities and enable early action measures.</p> <p>Broad activities include:</p> <ul style="list-style-type: none"> <li>• Harmonization of warning criteria for hydromet hazards, given their cross-boundary nature in SEA region to improve data sharing and</li> </ul>
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	<p>enable sub-regional cooperation for climate and disaster risk management;</p> <ul style="list-style-type: none"> <li>• Enhancing capacities of sector government entities (agriculture, water resources, health, disaster management, social protection, etc.) in the region for drought adaptation and mitigation;</li> <li>• Enhancing capacities for Early action and rollout ASEAN disaster responsive social-protection guidelines;</li> <li>• Development and/or improvement in existing Service Delivery Mechanisms with the target products for EWS inclusive of DRM;</li> <li>• Pilot testing existing IBFWS (if possible, by focusing on cross-boundary pilot areas) using Community Based Flood Management (CBFM) practices adopted from the Associated Programme on Flood Management (APFM) programme; and</li> <li>• Conducting assessments of risk communication, local and indigenous knowledge integration and last-mile connectivity of MHEWS in the region to support national/local EWS strategies' enhancement Overall, identify and address challenges to strengthen early warning dissemination channels and improve end users' response by exploring engagement with the private sector and civil society organizations, women's groups and person with disability, school community, health authorities, farmers' organizations, infrastructures' constructors and operators (e.g. dams operators) potentially in the same cross-boundary pilot areas as above.</li> </ul>
<b>Overall Budget</b>	US\$ 5,539,237
<b>Timeframe</b>	4 years
<b>Partners</b>	WMO, World Bank; UNDRR, Department of Meteorology and Hydrology, Lao People's Democratic Republic (Lao PDR), Department of Meteorology, Cambodia, Ministry of Water Resources and Meteorology, Cambodia; Ministry of Natural Resources and Environment, Lao PDR; National Committee on Disaster Management Cambodia and National Disaster Prevention and Control Committee, Ministry of Labor and Social Welfare

<b>Country/Region</b>	<b>Curaçao, Sint Maarten and Aruba</b>							
<b>Profile</b>	<b>Level of Disaster Risk</b>	St Maarten: High Curaçao and Aruba: medium	<b>Average annual loss to disasters</b>		<b>Access to information &amp; communications (ICT index)</b>	Medium	<b>Capacity of NMHS</b>	Medium
	<b>Status of hydromet and EWS</b>	Medium	<b>Disaster loss and risk data to inform early warning</b>		<b>Demand/Priority</b>	High	<b>Leveraging potential</b>	Medium

<b>Context</b>	This project covers the three islands of Curaçao, Aruba and Sint Maarten, constituent countries within the Kingdom of the Netherlands. Since October 2010, Curaçao and Sint Maarten constitute a single group membership as a WMO member territory. Sint Maarten in the north-eastern Caribbean, is located well within the hurricane belt and tropical cyclones make landfall on average every 4-5 years. In September 2017, Sint Maarten was severely hit by Hurricane Irma, causing extensive damage to communication systems, roads, power grid and housing <sup>12</sup> . The damage assessment taking place shortly after reported 39% of building completely destroyed or highly damaged. Only 9% of buildings were not affected (Reliefweb). The islands of Aruba and Curaçao in the southern Caribbean are on the southern fringes of the hurricane belt and the occurrence of tropical cyclones is lower. However, In 2004 Aruba experienced severe flash floods caused by a very active spiral band of Hurricane Ivan (300mm in 6 hours). Tropical Storm Omar in 2008 caused coastal flooding and damage to beach facilities on both islands and Tropical Storm Tomás in 2010 caused significant damage and two deaths due to severe flash floods (350 mm in 5 hours) in Curaçao. The proposed project aims at strengthening the warning capabilities of the National Meteorological Services of Curaçao, Sint Maarten and Aruba to deliver tailored services to their communities.
<b>Priority Needs</b>	High priority needs to improve EWS in Curaçao, Aruba and Sint Maarten include: <ul style="list-style-type: none"> <li>• <b>Flash flood guidance system</b> - to develop a flash flood model for the islands, including mapping of vulnerable areas</li> <li>• <b>Coastal Inundation forecasting</b> - impact based coastal inundation forecasting, identifying vulnerable areas and disseminating timely warnings for inundation events;</li> <li>• <b>Product development</b> - review the current warning bulletins and information material, using the guidelines of the WMO, regarding impact based forecasts and warnings. This should result in the development of an improvement of the warning capabilities of the NMSs.</li> <li>• <b>Product generator</b> - to develop an automated product generator of warning messages for the islands that can be used to take the necessary action, in case of severe weather events.</li> <li>• <b>Automated dissemination generator</b> - develop an automated dissemination generator to disseminate warning messages in a timely manner for the islands that can be used to take the necessary action, in case of severe weather events.</li> </ul>
<b>Overall Budget</b>	USD 1,650,000
<b>Timeframe</b>	3 years
<b>Partners</b>	WMO (lead) World Bank Finnish Meteorological Institute (FMI) Royal Netherlands Meteorological Institute (KNMI)

<sup>12</sup> [https://www.cia.gov/library/publications/the-world-factbook/geos/print\\_sk.html](https://www.cia.gov/library/publications/the-world-factbook/geos/print_sk.html)



<b>Country/Region</b>	Ethiopia							
<b>LDC or SIDS Profile</b>	<b>Level of Disaster Risk</b>	High	<b>Average annual loss to disasters</b>	Data not fully available.	<b>Access to information &amp; communications (ICT index)</b>	Ranked 170 <sup>th</sup> in the ITU's ICT Development Index <sup>13</sup> 2017	<b>Capacity of NMHS</b>	Low <sup>14</sup>
	<b>Status of hydromet and EWS</b>	Low	<b>Disaster loss and risk data to inform early warning</b>	400+ Disaster Risk Profiles conducted of the total 800+ Woredas/Districts in the country.	<b>Demand/Priority</b>	High	<b>Leveraging potential</b>	High
<b>Context</b>	<p>The climate of Ethiopia is complex and vulnerable to changes in the El Niño Southern Oscillation (ENSO) which can cause erratic or complete failure of seasonal rainfall. Contrary to model projections, observations have shown that droughts and heavy rainfall/flooding have been experienced more frequently during the last 30 to 60 years in East Africa, both of which have led to significant displacement of people. Erratic rainfall, combined with the projected 2°C increase above pre-industrial temperatures by 2050 will lead to further heat waves, droughts and floods which would exacerbate crop failure, land degradation, diseases and poor human health, reinforcing the cycle of poverty in both rural and urban areas.</p> <p>Ethiopia is one of the poorest countries in the world, with 46% of the population being Ethiopians requiring food aid growing by more than half a million per year (Regassa et al. on agriculture which employs about 80% of the country's population and contributes Most farming in Ethiopia is done on small-holdings with 87% of rural households work al. 2010). This combination of factors means that few Ethiopian households have the adaptability is low and their vulnerability to hydro-meteorological hazards also Ethiopia's coffee industry is likely to be negatively affected by rising temperatures unless growing methods are adapted. Increasing temperatures are also like Ethiopian highlands, amongst other insect-transmitted diseases. The reduction in rural people into urban environments. The rapid urbanization of Ethiopia places sanitation which will be exacerbated during periods of further climatic variability.</p> <p>In Ethiopia, the National Meteorological Agency (NMA), the Hydrology and Water Quality Directorate (HWQD) of the Ministry of Water, Irrigation and Electricity (MoWIE) and River Basin Authorities (RBAs) are regarded as the providers of public hydromet services. NMA is mandated to provide early warning advice on the adverse effects of extreme weather conditions and is obliged to fulfil</p>							

<sup>13</sup> <http://www.itu.int/net4/ITU-D/idi/2017/>

<sup>14</sup> UK Met Office, GFDRR and the World Bank (2016), Multi-Hazard Early Warning Assessment

	<p>international obligations with regards to issues of meteorology. The Agency, since its establishment in 1980s, has developed and operated a national network of meteorological stations designed to represent various climatic regions of Ethiopia and to satisfy the needs of various national development plans and activities. However, NMA still requires a significant support with a focus on systems development, institutional capacity building and service delivery to respond adequately to growing needs for more elaborate and sophisticated information services. MoWIE/HWQD is responsible for collecting, managing and disseminating hydrology data information and services at the national level. In recent years, the legal framework for the establishment of River Basin Authorities (RBAs) has been put in place. Three out of the planned 12 RBAs have been established to date. One of the focuses of MoWIE/HWQD and RBAs is to develop customer orientated services through improved modelling, analysis, presentation, and reporting, to enable stakeholders and customers to derive greater benefit from hydrological, groundwater and water quality data and information. Currently stronger emphasis is put on data collection, on which, MoWIE/HWQD and RBAs wish to build capability to develop and delivery basic services including flood and drought forecasting and hydrological information services for better water resources management. In addition to these hydromet agencies, in Ethiopia, the National Disaster Risk Management Commission (NDRMC) is playing a key role in providing early warning services. NDRMC is currently finalizing the district level disaster profiles, which will go a long way to support the establishment of more localized risk informed early warning services. Given the GoE's recognition of hydromet services as key public services for sustainable development and climate and disaster risk management, there is a good opportunity that the CREWS project would leverage additional funds from sources such as IDA and GCF for advancing the modernization of hydromet and climate services and early warning systems.</p>
<p><b>Priority Needs</b></p>	<p>The GoE has recently developed five years strategic plans for hydromet and climate services with support from WB/GFDRR, which identified the following goals:</p> <p><i>For NMA</i></p> <ul style="list-style-type: none"> <li>• Enhance provision of reliable, co-produced and accessible weather and climate services based on better data, information, knowledge and tools that inform East African, national, regional states, zonal and woreda level policy, planning and decision-making in Ethiopia.</li> <li>• Engage with decision makers and the population, while ensuring a good gender balance, to ensure that they are informed and prepared to manage hydro-meteorological hazards. This will contribute to socio-economic growth and reduce the impact of weather and climate on lives and livelihoods.</li> <li>• Endeavour to fulfil international and regional commitments, and align with global policies to support government of Ethiopia engagement worldwide.</li> <li>• Strengthen research and studies for the improved provision of weather and climate operational services and applications.</li> </ul> <p><i>For HWQD/MoWIE</i></p> <ul style="list-style-type: none"> <li>• Modernize the existing monitoring, collection and archiving infrastructure, further expand the monitoring network and deliver a full data processing and management service.</li> </ul>

	<ul style="list-style-type: none"> <li>• Develop customer orientated services through improved modelling, analysis, presentation, and reporting, to enable stakeholders and customers to derive greater benefit from hydrological, groundwater and water quality data and information.</li> <li>• Improve the ability of communities to manage hydro-meteorological hazards, through enhancing capabilities in flood forecasting and early warning, flood control and drought analysis by working and collaborating with partners (RBA's, NMA, NDRMC, etc.)</li> <li>• Strengthen national oversight role through improving the national water quality supervision and control system.</li> <li>• Support capacity building within HWQD and RBAs by enhancing opportunities for the professional development of hydrology in Ethiopia at all levels.</li> </ul> <p>While it is expected that fund to be leveraged will be invested towards achieving these goals, key priority actions to make such an integrated modernization more effective, thus considered as priority needs, would include institutional capacity building, development of the concept of operations and service delivery strategy, identification, development and operationalization of priority services, strengthen the communication link between the providers and the local users, enhancement of the capacity of users to understand and utilize climate and hydrological information products in a gender inclusive manner, and the use of hydromet early warning information for decision making at different levels.</p>
<b>Overall Budget</b>	\$ 3.0 million
<b>Timeframe</b>	3 years
<b>Partners</b>	World Bank (lead), WMO

<b>Country/Region</b>	<b>Madagascar</b>							
<b>Profile</b>	<b>Level of Disaster Risk</b>	High <sup>15</sup>	<b>Average annual loss to disasters</b>	US\$ 100 million	<b>Access to information &amp; communications (ICT index)</b>	Ranked 169 in the ITU's ICT Development Index 2017	<b>Capacity of NMHS</b>	Low <sup>16</sup>

<sup>15</sup> <http://documents.worldbank.org/curated/en/262521494235299571/pdf/114366-FRENCH-WP-PUBLIC-drp-madagascar-fr.pdf>

<sup>16</sup> GFDRR, 2017. Madagascar: Assessment on the State of Hydrometeorological Services and Recommendations for their Improvement

	<b>Status of hydromet and EWS</b>	Low	<b>Disaster loss and risk data to inform early warning</b>	National-level disaster risk assessment completed and published <sup>17</sup>	<b>Demand/Priority</b>	High	<b>Leveraging potential</b>	Medium Leveraging will be sought from regional and national IDA allocations, and the Green Climate Fund.
<b>Context</b>	<p>Madagascar is a mountainous island nation with unparalleled biodiversity and significant natural wealth, which serve as great resources for the country's economy. Agriculture, including fishing and forestry, employs roughly 80% of Madagascar's work force and accounts for more than 25 percent of the country's GDP. Due to its location, topography and socioeconomic conditions, Madagascar is one of the world's most exposed and vulnerable countries to climate change and extreme weather events, with the most likely risks involving cyclones, flooding, and drought. A disaster risk modeling study completed at the end of 2016 shows that Madagascar faces Average Annual Losses (AAL) of US\$100 million (or more than 1% of GDP) for all combined hazards (cyclone, flood and earthquake). From 1990 to 2015, at least 65 major climate-related disasters were recorded in Madagascar, with more than 50 cyclones. The country's resilience is constrained by the pre-existing vulnerability of the population and the weakness of the public infrastructure and services.</p> <p>Effective management of weather-related disasters is limited by weak hydrological and meteorological capacities. Observations in Madagascar started in 1897. The number of operating surface meteorological observing stations, however, is limited to 23. Out of the current twenty-three operating stations, nineteen are operated by the Directorate General of Meteorology (DGM) and four by ASECNA. Most of these stations are manual using old technology, and observed data are stored on paper records. The DGM field meteorologists can produce adequate METAR and SPECI aviation reports, however they need capacity building and appropriate hardware and software to improve their current meteorological aviation reports and to be able to produce other reports such as the TAF and SIGMAT. There are no maritime weather monitoring stations in Madagascar. The existing climatological and rainfall monitoring networks are far from adequate. More than 80% of the climatological stations were abandoned, only twelve stations are currently operational compared to around 140 stations in 1960. Similarly, there were more than 350 operating rainfall stations in 1960, with only 52 currently active as most of the stations were abandoned over the years.</p> <p>In addition, the capacity to manage hydro-meteorological data is weak. There is a lack of centralized information systems for adequate production and distribution of finalized products and services to users. The high percentage of missing data indicates an urgent need to improve data processing, checking and validation operations. The DGM has a large amount of meteorological and</p>							

<sup>17</sup> <https://www.gfdr.org/en/publication/disaster-risk-profile-madagascar>

	<p>hydrological data in hard paper.</p> <p>The current weather forecasting service at the DGM provides only basic qualitative weather forecast such as strong wind, low temperature, high chance of rainfall, low visibility etc. The DGM has no weather forecasting system specifically developed for Madagascar. Capacity development of the weather forecasting and service delivery staff is required to produce reliable weather forecasting and early warning services for disaster reduction and recovery given the high vulnerability of Madagascar to hurricanes and tropical cyclones. In addition, there are only weak synergy between the weather forecasting and hydrological forecasting operations for flood forecasting and early warning services.</p> <p>The Government of Madagascar is aware of the important role of hydrometeorological services in sustainable development, agriculture and disaster risk management. As such, there is a good opportunity that the CREWS project would leverage additional funds from sources such as IDA and GCF for advancing the modernization of hydrometeorological services.</p>
<b>Priority Needs</b>	<p>High priority needs include improvements in basic public services, including the capacity to optimally utilize current equipment and to transition to new technologies and expanded networks. In addition, coordination between agencies and communication with the public need further improvement. To address the limitations of hydrometeorological services in Madagascar, an integrated approach of technical assistance and investments in equipment are needed. With support from GFDRR, an assessment of the hydrometeorological system was conducted in 2016. The assessment has led to the identification of a number of key priorities. On the technical assistance side, priority activities would include:</p> <ul style="list-style-type: none"> <li>• Align the services of the DGM with the sector users' needs and build its capacity to make the transition from data providers to data and information services providers.</li> <li>• Understand and harmonize the Hydrometeorology monitoring networks density to cover ungauged areas and meet the sector users' needs.</li> <li>• Harmonize installation, operation, and maintenance procedures.</li> <li>• Develop capacity of field meteorologists and hydrologists in data collection and maintenance of modern monitoring systems and transmission technologies.</li> <li>• Improve the weather forecasting hardware and software and support the development of a weather forecasting model tailored to Madagascar's meteorological conditions.</li> <li>• Strengthen synergy between the weather forecasting and hydrological forecasting operations for improved flood forecasting and early warning services.</li> <li>• Strengthen the capacity in SIOMA<sup>18</sup> integrated aeronautical meteorological observation system.</li> <li>• Build capacity in accessing, processing, and analysing weather satellite data and information.</li> <li>• Progressively establish a routine upper air/atmospheric monitoring network under DGM.</li> <li>• Strengthen capacity to improve the aviation sector level of satisfaction for METAR and SPECI and build capacity to develop skills</li> </ul>

<sup>18</sup> Système intégré d'observation météorologique aéronautique

	<p>for the preparation of TAF and SIGMAT.</p> <ul style="list-style-type: none"> <li>• Progressively establish a routine marine weather monitoring network under DGM.</li> <li>• Strengthen and modernize Flood forecasting and service delivery service in collaboration with the National Disaster Management Agency (<i>Bureau National de la Gestion des Risques et Catastrophes</i> – BNGRC, Ministry of Interior), Emergency Management and Prevention Unit (<i>Cellule de Prévention et Gestion des Urgences</i> – CPGU, Prime Minister’s Office), Civil Protection Corps (<i>Corps de Protection Civile</i> - CPC, Ministry of Defense), and other relevant entities.</li> <li>• Ensure that early warning information is disseminated in a gender-sensitive way, so that improved early warning systems will directly address women’s vulnerabilities and exposure to disaster risk.</li> </ul> <p>Funding from CREWS would be instrumental in starting to address the technical and institutional capacity priorities. In parallel, national and regional IDA as well as GCF funding would be sought to address investment needs in observation and monitoring equipment.</p>
<b>Overall Budget</b>	\$ 3.0 million
<b>Timeframe</b>	3 years
<b>Partners</b>	World Bank (lead), with WMO, SECNA, and AFD

<b>Country/Region</b>	<b>Mozambique</b>							
<b>Profile</b>	<b>Level of Disaster Risk</b>	High	<b>Average annual loss to disasters</b>	>US\$ 150 million <sup>1</sup>	<b>Access to information &amp; communications (ICT index)</b>	Ranked 150 <sup>th</sup> in the ITU’s ICT Development Index 2017	<b>Capacity of NMHS</b>	Medium

	<b>Status of hydromet and EWS</b>	Medium	<b>Disaster loss and risk data to inform early warning</b>	National-level disaster risk assessment & financial protection study completed <sup>19</sup>	<b>Demand/Priority</b>	High	<b>Leveraging potential</b>	High The proposed CREWS grant would be leveraged directly by a \$80 million World Bank P for R operation
<b>Context</b>	<p>Mozambique has been impacted twice in the last month by cyclones. These have tested the state of the current early warning systems. WMO and the World Bank will have teams working with the government in the coming weeks to evaluate what has worked well and what needs further improvements. Information from these engagements would inform and shape a final proposal should we be invited to present one.</p> <p>Mozambique is highly-exposed and vulnerable to natural hazards and climate variability with drought, flooding, and tropical cyclones comprising the most frequent climate shocks. The frequency and intensity of climate-related shocks have intensified over the past four decades. Over half of its population is vulnerable to climate-related shocks and the impacts of disasters on the country's budget and economy are sizable. Assets worth approximately 37 percent of GDP are exposed to two or more natural hazards, which translates into 1.1 percent annual average loss in GDP. The costs of the 2000 floods were estimated at almost US\$ 450 million (or nearly 9% of GDP) and for the Limpopo river floods in 2013 the sum exceeded US\$ 517 million (both at current values).</p> <p>Effective early warning for flood and cyclone is particularly important in Mozambique. Because of the sheer size of the country and the limited government budget, it is impossible for the government to provide effective flood protection and cyclone-resistant buildings in all high-risk areas. Large parts of the population therefore rely on Local Disaster Risk Management Committees (<i>Comitês Locais de Gestão do Risco de Calamidades</i>) and individual early action as a first line of defense. It is therefore imperative that reliable and actionable early warning information is produced and transmitted to the local level within a short time span.</p> <p>The responsibilities within the national early warning system are spread across institutions. For weather and flood warnings, the INGC holds overall coordination responsibilities for the system, but monitoring is carried out by the National Directorate of Water (NDA), which is responsible for flood forecasting, in collaboration with INGC and the National Institute of Meteorology (INAM). INAM is responsible for routine and severe weather forecasts and warnings, including thunderstorms and tropical cyclones. INAM is also the national focal point for tsunami warnings. Other national and provincial information providers include ARA – Regional Water Authority; MINAG – Ministry for Agriculture; IIAM – Institute for Agrarian Research; DNSA – National Directorate for Agriculture Extension; INAMAR – National Maritime Institute; IDPP – Institute for the Development of Artisanal Fishery; INAHIMA – National Institute for Hydrography and Navigation. In addition, DNG – National Directorate for Geology provides earthquake related information.</p>							

<sup>19</sup> World Bank, 2018. Financial Protection against Disasters in Mozambique. Available at: <https://www.gfdrr.org/sites/default/files/publication/bm-brochura-pfc-en.pdf>

	<p>INGC is responsible for translating early warning information into alerts and communicating these to local actors. This information flows between local actors and INGC is critical for an up to date understanding of the situation and to direct relief efforts accordingly. The government expects international partners to act as one during disaster response, which should improve the effectiveness of the emergency response. However, current evidence suggests that there is too much dependence on personal contacts rather than well-defined institutional structures<sup>20</sup>. Important gaps exist across the information flow, including in institutional collaboration, lack of centralized information processing, limited accuracy and geographical coverage, and lack of last-mile connectivity of warnings to people at risk as the main bottlenecks in the national early warning cycle. Previous donor-funded pilots have created a strong baseline understanding of possible options to address some of these challenges, for example through the centralized SMS-based dissemination system (<i>DataWinners</i>) developed by USAID and the community-based forecast-based action projects of the Red Cross. However, to date such pilots have been limited to small areas and have not been incorporated in the institutional way of working nor upscaled to the national level.</p> <p>The World Bank is currently preparing a \$80 million Program for Results (PforR) operation that will support the Government’s overall disaster risk management program, including (1) the establishment of a DRM fund; (2) the procurement of sovereign risk insurance; (3) investments in school retrofit against flood and cyclone; (3) the strengthening of local DRM committees across risk areas; and (4) the strengthening of the national early warning system. CREWS funding would be instrumental in steering the implementation of the components on local DRM committees and early warning systems and would directly leverage the \$10 million that is budgeted for those components.</p>
<b>Priority Needs</b>	<p>Recent engagements of the World Bank and its partners on early warning, including a Bank lending project on hydro-meteorological services<sup>21</sup> and a recently completed study on early warning information flows<sup>22</sup>, have shown that the bottlenecks in the Mozambican system are shifting to information processing, institutional coordination and information dissemination more so than equipment. Based on the assessments and an ongoing dialogue with INAM, DNA and INGC, three key priorities for improving early warning systems have been identified as priority needs: (1) further strengthening the modelling of critical levels and impact-based early warnings, especially related to river flooding; (2) strengthening inter-institutional collaboration and centralized information management; and (3) strengthening the dissemination system to reach at-risk communities with timely and actionable information.</p> <p>The proposed approach is broken down in the following specific activities:</p> <ul style="list-style-type: none"> <li>• <b>Modeling &amp; Alerts:</b> identification of priority risk zones for which no flood alerts are being produced; strengthening of real-time flood hazard models in one or two priority areas, based on international advances in the use of global modelling tools (e.g.</li> </ul>

<sup>20</sup> República De Moçambique Ministério Da Planificação E Desenvolvimento Ministério Da Administração Estatal (2014). Rules, Procedures and Standards for the Flow of Information on Disasters

<sup>21</sup> Enhancing Spatial Data for Flood Risk Management Project (P149629)

<sup>22</sup> República De Moçambique Ministério Da Planificação E Desenvolvimento Ministério Da Administração Estatal (2014). Rules, Procedures and Standards for the Flow of Information on Disasters



	<p>GLoFAS; GLOFFIS) and available national data and models.</p> <ul style="list-style-type: none"> <li>• <b>Institutional Coordination:</b> establishing updated MoUs between the main agencies involved in the EWS information flow (at least DNA; INAM; INGC); review of the current translation of technical alert information into early warning levels and developing an improved method; strengthening the systematic links between national and sub-national entities in order to improve information flow.</li> <li>• <b>Dissemination system:</b> reviewing the best practices in disseminating early warning messages to the community level in a trackable and systematic way, both in Mozambique and internationally; institutionalizing one systematic methodology that can be upscaled nationally, potentially based on currently piloted SMS-based systems; connecting communities in priority risk areas to the system and testing.</li> </ul> <p>The proposed approach explicitly follows CREWS priorities:</p> <ul style="list-style-type: none"> <li>• <b>Sustained engagement with country institutions:</b> the proposed project is fully embedded in country systems and institutions. The approach addresses both institutional and technical gaps, and aims to build on systems and tools that have proven to be effective in the local institutional context.</li> <li>• <b>Coherence promotion:</b> the activity aims to strengthen coherence in the national early warning system by reviewing existing pilot activities and converging to a single, systematic and transparent flow of information from modelling to community alerts.</li> <li>• <b>Solution orientation:</b> the activities will be designed with the final end goal in mind, i.e. increasing the number of communities that receive reliable and actionable early warning information. The project would do little to no base data creation that is disconnected from this final purpose.</li> <li>• <b>People-centered focus:</b> as per the design of the Program for Results operation, the engagement of early warning system strengthening will go hand in hand with the strengthening of Local Disaster Risk Management Committees (<i>Comitês Locais de Gestão do Risco de Calamidades</i>) at the community level. These committees, made up from voluntary community members, will be the main beneficiaries of the information and will very much steer the design of the proposed dissemination system.</li> <li>• <b>Gender-sensitive approach:</b> the Local Disaster Risk Management Committees are generally made up of 50% male and 50% female members. In the design of the improved early warning dissemination system, great care will be given to tailoring the messaging to both male and female community members.</li> <li>• <b>Investment multiplier:</b> the proposed CREWS grant would directly leverage at least \$10 million of World Bank financing through the \$80 million PforR operation. In addition, it will leverage previous investments in hydromet equipment by the World Bank, GIZ and other partners, by turning that data into actionable information at the community level.</li> </ul>
<b>Overall Budget</b>	\$ 2.0 million
<b>Timeframe</b>	3 years
<b>Partners</b>	World Bank, WMO, Mozambican Red Cross

Country/Region	South West Indian Ocean (Comoros, Madagascar, Mauritius, Mozambique, Seychelles, UR Tanzania)							
Profile	Level of Disaster Risk	High	Average annual loss to disasters (million USD, from earthquakes, floods and tropical cyclone – drought is not taken into account)	Comoros: 5,7 Seychelles: 2,8 Mauritius: 110 Madagascar: 100 Mozambique: 150 UR Tanzania: 27.7 <sup>23</sup>	Access to information & communications (ICT index)	Seychelles: 5.03 Mauritius: 5.88 Comoros: 1.82 Madagascar: 1.68 Mozambique: 2.32 UR Tanzania: 1.81 <sup>24</sup> (scale 1-10)	Capacity of NMHS	Seychelles : Medium Mauritius: Low Comoros: Low Madagascar: Low Mozambique: Medium UR Tanzania: Low
	Status of hydromet and EWS	Low, except for tropical cyclone forecasting	Disaster loss and risk data to inform early warning	Limited	Demand/Priority	High	Leveraging potential	High
Context	<p>The implementation of this regional project will be led by WMO and involve the World Bank and UNDRR, in close coordination with the Indian Ocean Commission (IOC) (French: Commission de l'Océan Indien, COI). It will benefit in total 6 coastal LDCs and SIDS in the South West Indian Ocean.</p> <p>The IOC is an intergovernmental organization composed of five African Indian Ocean nations: Comoros, Madagascar, Mauritius, France (La Réunion, an overseas department), and Seychelles. Within the IOC, Mauritius and Seychelles are SIDS, Madagascar is a LDC and Comoros is both a SIDS and a LDC. In addition, Mozambique and UR Tanzania are both LDCs.</p>							

<sup>23</sup> <https://www.gfdr.org/sites/default/files/comoros.pdf>, <https://www.gfdr.org/sites/default/files/madagascar.pdf>, <https://www.gfdr.org/sites/default/files/mauritius.pdf>, [https://www.gfdr.org/sites/default/files/publication/mozambique\\_low.pdf](https://www.gfdr.org/sites/default/files/publication/mozambique_low.pdf), <https://www.gfdr.org/sites/default/files/seychelles.pdf>, <http://riskprofilesundrr.org/documents/1852>

<sup>24</sup> <https://knoema.com/ITUKIICT2019Apr/global-ict-developments>

Due to their geographical situation and topography, the South West Indian Ocean LDCs and SIDS are particularly vulnerable to extreme weather events, including tropical cyclones, climate events such as droughts, and climate variability and change. A large percentage of the population live in coastal areas where tropical cyclones generating wind, flood and storm surges constitute a significant threat. At the same time, the investment in hydrometeorological services and early warning systems remains low.

A number of activities are either in the pipeline ongoing at the IOC and in the target countries:

- The Agence française de développement (French Development Agency (AFD)) is appraising a 74 million USD project titled Building Regional Resilience through Strengthened Meteorological, Hydrological and Climate Services in the Indian Ocean Commission Member Countries (Hydromet Project) with financing from the Green Climate Fund (GCF), EU Intra-ACP program and AFD, to provide investment resources for the IOC Member States. WMO provided technical guidance and advice during the project feasibility study;
- The World Bank as part of Mozambique Disaster Risk Management and Resilience Program (P166437) is supporting (i) technical assistance to advise INGC, INAM, and DNGRH on the development and implementation of integrated early warning systems (800,000 USD, see DRM program para 33) and (ii) “creation of new and revitalization of existing local DRM committees by NGOs” (1500 committees, 9 million USD, see DRM program para 26), starting in May 2019;
- The United Nations Development Program (UNDP) is currently preparing a proposal for the Green Climate Fund to provide investment resources to Madagascar hydrological and meteorological services, in line with the investment plan prepared for the PPCR;
- SADC, with the SADB and GWP, is putting together a project proposal to the GCF for the SADC region, aiming at developing water information systems with DRR as a particular target. This system would upgrade the existing SADC Groundwater and Drought Management Portal, SADC Water Sector International Cooperating Partner Collaboration Portal and SADC GeoNetwork Portal - Water Datasets;
- The WMO Severe Weather Forecasting programme (SWFP – ongoing but underfunded) has been operating since 2006 with no external funding in all target countries. The programme would benefit from an update to the technical requirements from NMHSs and civil protection institutions, as well as from enhanced interfaces to enable easier use of SWFP products as input for national extreme weather forecast bulletins;
- The IOC Hydrological Cycle Observing System (HYCOS) project, which will be implemented as part of the AFD project. Detailed needs for investments and technical assistance for improving water monitoring and data management systems have been agreed upon Nov. 2019 by all IOC Member States;
- The Intra-ACP Climate Services Grant to the IOC (€6 million), which will be implemented as part of the AFD project, will setup a coordination framework to ensure operational functions of a Regional Climate Centre to deliver climate services to end

	<p>beneficiaries (private sector, policy makers, farmer associations, universities, etc.) through National Meteorological and Hydrological Services (NMHSs). The field of intervention is exclusively climate services and the expected results are: (i) interaction between the users, researchers and climate services providers through User Interface Platforms; (ii) access to climate services at regional and national level; (iii) capacity to generate and apply climate information and products is enhanced;</p> <ul style="list-style-type: none"> <li>- The RA I Tropical Cyclone Committee for the South West Indian Ocean developed some specific recommendations to improve the lead time, accuracy and reliability of tropical cyclone forecasting, and to better anticipate storm surge impacts in the region;</li> <li>- The Southwest Indian Ocean Risk Assessment and Financing Initiative (SWIO-RAFI - closed), co-financed by the ACP-EU NDRR Program and the ACP-EU Africa Disaster Risk Financing (ADRF), developed country risk profiles to improve the understanding of disaster risks for Comoros, Madagascar, Mauritius and Seychelles;</li> <li>- The NORCAP-funded Adaptation Programme in Africa (GFCS APA) Phase II: Building Resilience in Disaster Risk Management, Food Security and Health, aims to enhance capacity of national meteorological and hydrological services to better anticipate and respond to extreme weather events and climate change, with a specific focus on specifically for agriculture and food security, health, and disaster risk reduction;</li> <li>- The DFID-funded HIGH impact Weather Lake System project (HIGHWAY), which supports the national meteorological service of Tanzania to issue customized forecasts and warnings for Lake Victoria coastal areas, with inputs from the Severe Weather Forecasting program (SWFP);</li> <li>- The Inclusive Agricultural Value Chains Development Programme (DEFIS) initiative in Madagascar, which seeks to enhance the adaptive capacity of agricultural systems and vulnerable rural communities to the adverse impacts of climate change through its GCF-funded DEFIS+ co-financing (USD 15M), notably through the installation of agro-meteorological weather stations and dissemination of agro-meteorological data in the country;</li> <li>- The 8 million EUR FocusAfrica project, recently approved by the European Commission for implementation by WMO and partners, seeks to develop full-value chain climate services and document associated economic benefits in the agriculture, water, energy and infrastructure sectors in Southern Africa. The products, results and lessons learned will be upscaled throughout the SADC region through WMO operational systems and processes in the region. Tanzania is a focus country.</li> </ul>
<b>Priority Needs</b>	<p>The priority needs for the South West Indian Ocean LDCs and SIDS to be covered by CREWS would include:</p> <ul style="list-style-type: none"> <li>- Strengthening the governance of NMHS, ensuring that the necessary strategic and legal frameworks and standard operating procedures are in place for their optimal contribution to EWS. This will ensure the basic capacities of the NMHS developed under the AFD investment are in line with international norms, standards and latest practices, and facilitate collaboration with EWS stakeholders with clear understanding of user requirements (civil protection, food security, water and sanitation authorities, municipalities, etc.);</li> <li>- Training of NMHS staff, including joint training with staff involved in early warning operations (civil protection, food security, etc.) and regional trainings involving all 6 countries;</li> </ul>

	<ul style="list-style-type: none"> <li>- Harmonized support to national hydrological services in line with the HYCOS project designed by WMO;</li> <li>- Providing technical inputs and guidance for optimal use of climate prediction capacities developed under the Intra-ACP Climate Services program for early warning, including (i) enhancing South West Indian Ocean Climate Outlook Forum (SWIOCOF) governance; (ii) developing a customized Climate Services Toolkit (CST) for the SWIO Region; (iii) developing the SWIOCOF Portal; (iv) developing the SWIO RCC-Network; and (v) holding annual SWIOCOFs and associated pre-COF training workshops; and (vi) implementing phase 2 of Indian Ocean Data Rescue (INDARE);</li> <li>- Enhance the regional cooperation as part of the RA I Tropical Cyclone Committee for the Southwest Indian Ocean, through provision of in-country training on tropical cyclone forecasting and warnings and promoting the development of a "synergized standard operating procedure" for tropical cyclone forecasting at national level specifically to improve the lead time, accuracy and reliability of tropical cyclone forecasting and dissemination of information;</li> <li>- To better anticipate storm surge impacts in the RA I Tropical Cyclone Committee for the Southwest Indian Ocean SIDS and LDCs (Mozambique, Madagascar, Comoros, Mauritius, Madagascar, Seychelles);</li> <li>- Use outputs from the Southwest Indian Ocean Risk Assessment and Financing Initiative (SWIO-RAFI) and Building Disaster Resilience to Natural Hazards in Sub-Saharan African Regions, Countries and Communities project (Intra-ACP R1 and R5) country risk profiles to improve impact-based forecasting and anticipate priority needs for emergency response preparedness;</li> <li>- Strengthen the existing regional coordination mechanisms such as the South West Indian Ocean Climate Outlook Forum (SWIOCOF), Tropical Cyclone Committee (TCC), Regional meteorological Instrument calibration Center (RIC), Severe Weather Forecasting Program (SWFP); and support the setup of a new regional center for the WMO Integrated Global Observing System (WIGOS); to improve lead-time, accuracy, reliability and dissemination of forecasts and warnings of high-impact events;</li> <li>- Develop an early warning coordination mechanism and decision-support tool in UR Tanzania to support operational multi-hazard early warning;</li> <li>- Ensure optimal use of development resources for last-mile dissemination and preparedness, in line with the ongoing Disaster Resilience Program in Mozambique, and a similar regional program in preparation at the World Bank targeting the 4 IOC LDCs and SIDS;</li> <li>- Support identification of gender-disaggregated user requirements and development of gender-disaggregated warnings in the IOC region.</li> </ul> <p>A CREWS project for the SWIO would therefore enable provision of technical assistance from WMO, UNDRR and GFDRR/World Bank, in line with global standards, norms and latest practices, to ensure optimal use of development resources taking into account comparative advantages of partners and enabling balanced investments and technical assistance to key elements of EWS, in relation with 4 key investments from Intra-ACP (EU), AFD, GCF and IDA.</p>
<b>Overall Budget</b>	USD 4,000,000

<b>Timeframe</b>	5 years
<b>Partners</b>	WMO (lead), WB, UNDRR (contributing), Indian Ocean Commission, La Réunion Tropical Cyclone Specialised Center, Pretoria Severe Weather and Flash Flood Guidance Regional Specialised Meteorological Center, Australian Bureau of Meteorology, and others (partners)