



ANNUAL REPORT

2019



**Accelerating Life-saving Action,
Maximizing Finance Effectiveness**

Climate Risk and Early Warning Systems for Least Developed
Countries and Small Island Developing States



CREWS Report Series Annual Report 3 - 2019

Editor: Jennifer Ferguson-Mitchell

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Cover photo: Flooding in Haiti. Photo courtesy of UNICEF / Marco Dormino



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Photo credit: WMO/Daniel Pavlinovic

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INTRODUCTION

As we reflect on the progress made by the Climate Risk and Early Warning Systems (CREWS) initiative over the past year, what is immediately evident is the increase – the scaling up – of the services, expertise and resources made possible through CREWS to strengthen the early warning systems of Least Developed Countries and Small Island Developing States. The impact on lives and livelihoods is significant. Nearly one million people in Fiji alone now benefit from access to life-saving flash-flood early warning services thanks to CREWS support in 2019.

At the same time, though, as more and more extreme weather events continue to devastate communities around the globe, the urgent need to expand access to climate risk and early warning systems is growing. This has been recognized by the global community, most notably at the 2019 United Nations Secretary-General's Global Climate Action Summit and the UN Climate Change Conference (UNFCCC COP25).

With the support of the CREWS Trust Fund and the work of its Implementing Partners – the World Bank / Global Facility for Disaster Reduction and Recovery (GFDRR), the World Meteorological Organization (WMO) and the United Nations Office for Disaster Risk Reduction (UNDRR) – more countries and communities than ever before are gaining access to the advance information and knowledge that will save their lives when a severe weather event occurs.

In 2019, this scaling up of support, provided through the CREWS Trust Fund, expanded to 44 of the world's most vulnerable countries – and over 10 million people are gaining access to better early warning services. The United Kingdom joined the list of contributing CREWS Members this year, while Germany and France provided additional continued support – resulting in new commitments to the CREWS Trust Fund of US\$ 17 million in 2019 alone.

The CREWS initiative contributes its expertise and proven finance mechanism to a wider global community. It continues its successful partnership with the InsuResilience Global Partnership for Climate and Disaster Risk Finance and Insurance Solutions and maintains its strong relationship with the Green Climate Fund. The newly launched Risk-informed Early Action Partnership (REAP) seeks to bring more players and resources to the table. Likewise, CREWS expertise and data metrics will strengthen the new Alliance for Hydromet Development, which brings together the power of twelve of the world's leading development and humanitarian organizations to strengthen hydromet systems and services.

While clear successes and advancements are taking place, more is still needed to meet increasing demands. To do so, the 2020 funding target of US\$ 100 million set by CREWS Partners at its 2015 launch will need to be met.

As Chairperson of the CREWS initiative, I invite you to read this report, reflect on the work achieved, and to join Australia, France, Germany, Luxembourg, Netherlands, Switzerland and the United Kingdom to continue to close the gap between communities that have access to early warning systems, and those who do not.

The achievements of CREWS captured in this *2019 Annual Report* demonstrate the critical value of CREWS as a finance mechanism to accelerate action and maximize effectiveness of funding.

Carole Dieschbourg

Minister for the Environment, Climate and Sustainable Development,
Government of the Grand Duchy of Luxembourg;
and *CREWS Steering Committee Chairperson*





FOREWORD

Strengthening climate resilience in Burkina Faso, including the reinforcement of our critical extreme weather forecasting, early warning systems and communications services is a priority for our nation. Due to our geographical position, we expect to be increasingly impacted by changes in climate. We are already experiencing this, with more frequent high temperatures, pockets of drought and severe flooding at levels we have never seen before. These extreme weather events are putting at risk the lives and livelihoods of communities across the country.

In response, the Government of Burkina Faso is working to ensure that the nation has an enhanced technical capacity to forecast these extreme weather events and to provide early warnings to communities across the country, so that they may adequately prepare and respond.

We are very pleased to be supported in this effort by the Climate Risk and Early Warning Systems (CREWS) initiative. This important work is based upon an exhaustive capacity assessment of national institutions involved and provides a coordination mechanism for other projects currently ongoing in the country to support early warning systems and services. It ensures optimal use of partner and government resources.

It is estimated that adapting to climate change across Africa could cost US\$ 50 billion annually by 2050. The financial mechanism that CREWS provides to fund life-saving activities in Burkina Faso and in other Least Developed Countries and Small Island Developing States around the globe is therefore crucial.

We are very pleased that Burkina Faso, through its national meteorological service, was selected as the first CREWS country in Africa. The funding provided by the CREWS Trust Fund is already beginning to bear fruit. It has enabled us to improve agrometeorological services in three pilot areas making better use of forecasting in advisory bulletins to farmers. We expect to see, very soon, comparable improvements in hydrology, transportation and other economic sectors. CREWS has also enabled us to make progress on our Nationally Determined Contribution to the Paris Agreement on climate change, which includes this critical commitment to building climate change resilience.

We, therefore, encourage others to step-forward to support the important role of the CREWS initiative, and to become our partners in building a climate resilient world in which all people, everywhere can prosper.

Vincent Timbindi Dabilgou

Minister for Transport,
Urban Mobility and Road Security,
Government of Burkina Faso





Photo credit: UN/Logan Abassi

ABOUT CREWS

The specialized Climate Risk and Early Warning Systems (CREWS) initiative saves lives, assets and livelihoods through increased access to early weather warnings and risk information for people in Least Developed Countries (LDCs) and Small Island Developing States (SIDS) – the world’s most vulnerable countries.

CREWS was established in 2015 as a financing mechanism leveraging the expertise and specialist networks of its Implementing Partners the World Meteorological Organization (WMO), the World Bank Group / Global Facility for Disaster Reduction and Recovery (GFDRR) and the United Nations Office for Disaster Risk Reduction (UNDRR). As of December 2019, the CREWS Trust Fund has invested US\$ 37 million in projects in 44 LDCs and SIDS – and has mobilized an additional US\$ 270 million from public funds of other development partners.

It is driven by countries and expert partners, which CREWS projects put in the lead. This ensures the most urgent needs are met first and funds generate maximum impacts.

Australia, France, Germany, Luxembourg, Netherlands, Switzerland and the United Kingdom contribute to the pooled CREWS Trust Fund and provide oversight to CREWS operations through the CREWS Steering Committee, which is currently chaired by Luxembourg. Canada supports CREWS objectives through US\$ 8 million in additional funds to WMO for related CREWS activities, the 2019 results of which are included in this report.

The daily forecasts are very useful for vegetable crops because you can lose everything if rain occurs the same day as transplanting your plants.

Woman farmer in Burkina Faso



ACHIEVEMENT HIGHLIGHTS

AT A GLANCE

The CREWS initiative responds to the urgent needs of the world's most vulnerable populations through accelerated action and maximized effectiveness – and strives to be gender-responsive.

As of the end of 2019, this has achieved:

270
US\$ million additional funds leveraged by CREWS since its 2015 launch

10+ million additional people protected by
3 new national life-saving early warning systems launched in Fiji, Burkina Faso and Papua New Guinea in 2019

44 Vulnerable countries benefitted from CREWS country and regional project support in 2019

11 Country and regional projects supported by the CREWS Trust Fund in 2019

7 CREWS Trust Fund contributors: Australia, France, Germany, Luxembourg, Netherlands Switzerland, and new in 2019 – the United Kingdom

29 International institutions provided expert support to CREWS projects in 2019

197 900 CREWS Twitter impressions, with – **46% women** and **54% men** followers – expanding global early warning knowledge in 2019

27 400 CREWS website page views in 2019 alone – providing access to knowledge and resources – **and** **50 480** total page views since the website launched in 2016

4:1 Benefit cost ratio of investments in early warning systems

3-16
US\$ billion in potential losses avoided annually worldwide by early warning systems

PROJECTS

COUNTRY PROJECTS LAUNCHED

In 2019, CREWS launched three new country projects. In Afghanistan, hydromet and early warning services are now being strengthened for resilience. In Chad and Togo, support is being provided to strengthen the national capacity to deliver climate, hydromet and early warning services in select sectors and communities.

This brings the total to eight CREWS country projects and three regional projects, reaching a total of 44 countries.

PIPELINE COUNTRIES EXPANDED

In 2019, ten country projects have been brought into the pipeline – Benin, Bhutan, Cambodia, Curacao, Ethiopia, Haiti, Lao People’s Democratic Republic, Madagascar, Mozambique and Sierra Leone.

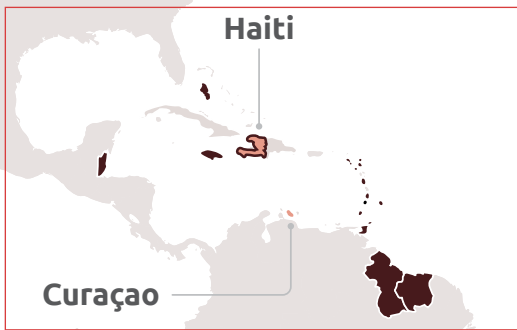
Results achieved in 2019 by the CREWS Trust Fund supported projects, and related CREWS projects funded by Canada through WMO, are highlighted in this report. An Indian Ocean regional project was also pipelined in 2019.

Pipeline countries and regions have a level of eligibility, ownership and readiness for the preparation of projects for potential future funding decisions.



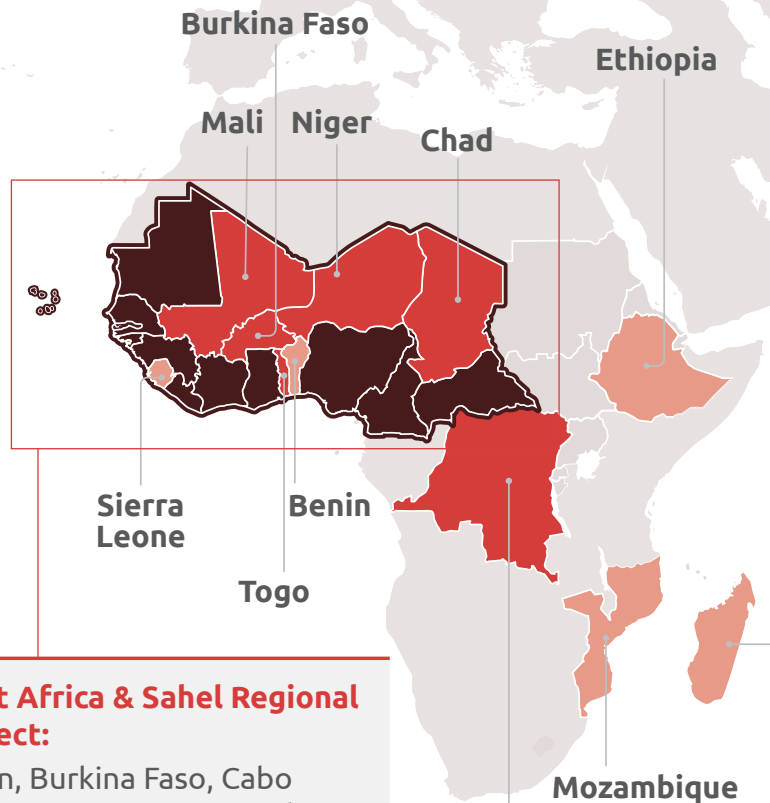
Photo credit: UNICEF/Marco Dormino

PROJECTS MAP



Caribbean Regional Project:

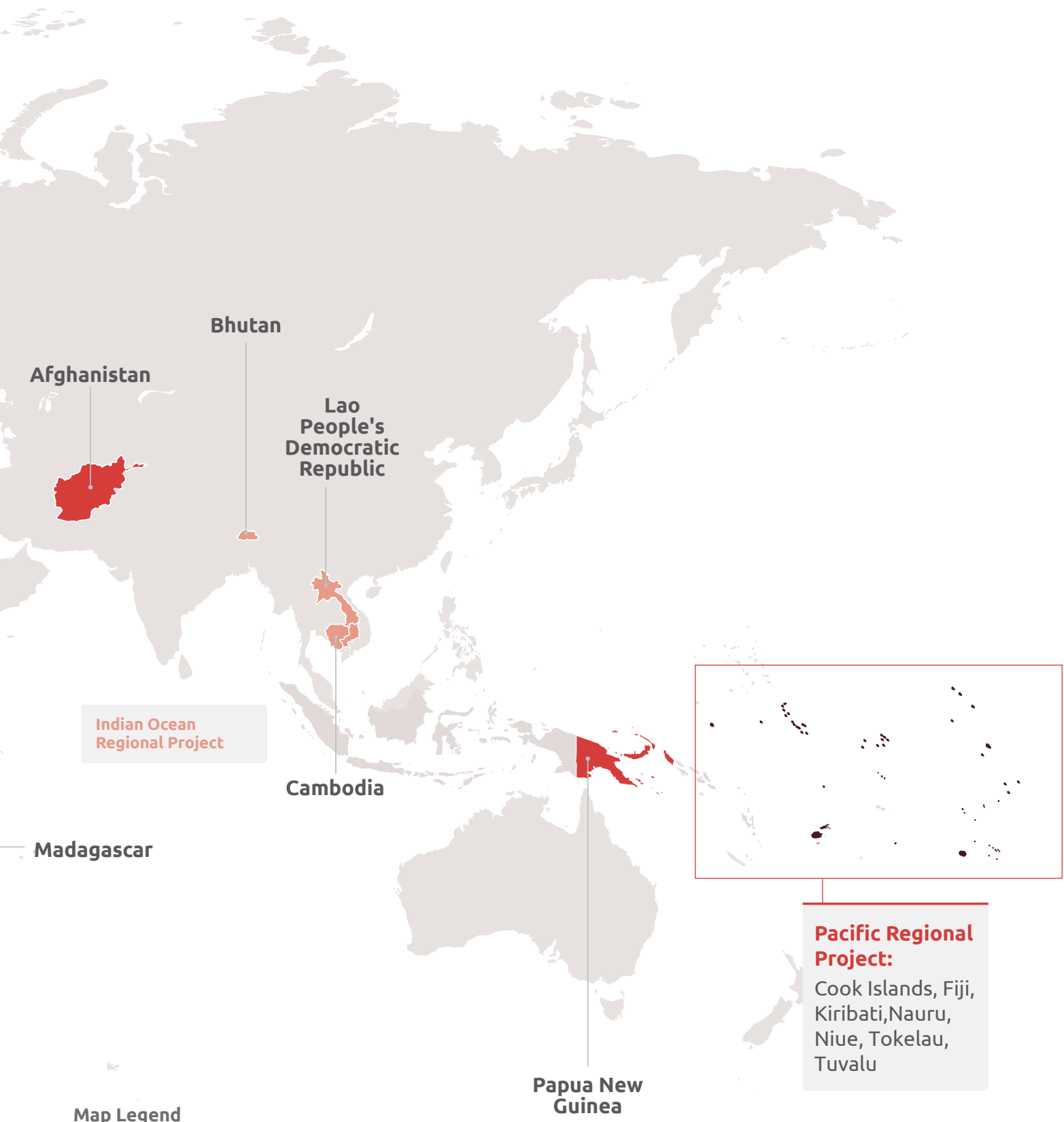
Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago



West Africa & Sahel Regional Project:

Benin, Burkina Faso, Cabo Verde, Cameroon, Central African Republic, Chad, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo

Additional LDCs and SIDS benefitting from CREWS related projects funded by the Government of Canada in 2019 are: Cambodia, Dominican Republic, Lao People's Democratic Republic, Marshall Islands, Palau, Samoa and Tonga.



Afghanistan

Bhutan

Lao People's Democratic Republic

Indian Ocean Regional Project

Cambodia

Madagascar

Papua New Guinea

Pacific Regional Project:
Cook Islands, Fiji, Kiribati, Nauru, Niue, Tokelau, Tuvalu

Map Legend

- Country Projects
- Regional Projects
- Country Pipelines and Regional Pipelines Projects*

* Pipeline countries and regions have a level of eligibility, ownership and readiness for the preparation of project proposals for potential future funding decisions.



PROGRAMME PERFORMANCE

The CREWS initiative measures its performance against the substantial reduction of global disaster mortality by working to significantly increase the capacity to generate and communicate effective, impact-based, multi-hazard early weather warnings and risk information in LDCs and SIDS.

The programme's progress is measured through a results-based framework against six national-level outputs, a regional-level output and a global-level output. The CREWS initiative also measures its impact against three global agreements, the United Nations Sustainable Development Goals, the Paris Agreement on climate change and the Sendai Framework for Disaster Risk Reduction 2015-2030.

For 2019, progress has advanced positively, ensuring CREWS continues to provide accelerated support to meet urgent LDC and SIDS needs, while also maximizing the effectiveness of funding.





PROGRESS AGAINST NATIONAL-LEVEL OUTPUTS

Output 1: Hydrometeorological service delivery improved

Through national-level Output 1, the CREWS initiative supports improvements to the service delivery of national meteorological and hydrological entities, including the preparation and implementation of long-term service delivery strategies and plans to meet the needs of end users. Strategic plans for National Meteorological and Hydrological Services (NMHSs) are based on the priority development needs of countries. They are recognized as central to the sustainable development of NMHSs and fosters closer cooperation between key government ministries and departments in charge of early warning systems. This output addresses the early warning element “Detection, monitoring, analysis and forecasting of the hazards and possible consequences”.

Progress highlights

- In Burkina Faso, a strategic plan for the national meteorological agency was prepared, supported by Météo-France and the private firm WeatherForce, providing a nationally owned vision for strengthening the country’s hydrometeorological services.
- In Chad, project implementation planning to strengthen the national capacity in early warning service delivery was advanced through dialogues held with project stakeholders.
- In the Democratic Republic of Congo, a strategic action planning exercise was supported to develop the National Framework for Climate Services. Initial activities were conducted to develop the Mettelsat Business Plan, a long-term financial model that will ensure the sustainability of the project through Mettelsat, the government’s hydromet services.
- In Niger, the decree on the national alert code was adopted, and two training workshops were held for elected officials on municipal preparedness and emergency response plans in the Zinder and Maradi regions.
- In Tuvalu, the Tuvalu National Strategic Plan and Meteorological Bill establishing the country’s meteorological service department was approved at the ministerial level and will be presented to the Parliament for endorsement. Also, a Tuvalu drought policy was developed for drought early warning based on la Niña, rainfall and water storage status in the capital of Funafuti.

More examples of CREWS impacts available at:
www.crews-initiative.org/impacts.

An accurate and timely early warning system can make the difference between life and death. In 2019, we developed new CREWS projects in Afghanistan, Chad, and Togo to help governments forecast better and alert people quickly about flood and drought risks. The CREWS Initiative can truly be transformative, increasing investments and providing wider economic, environmental, and social co-benefits such as gender inclusion. With our operational experience and the ability to leverage additional funding, the World Bank and GFDRR are helping to make that a reality. We look forward to seeing the long-term effect of these new country projects result in improved policies, institutions, and program designs that provide effective early warning services to the most vulnerable people.

*Bernice Von Bronkhorst, Global Director,
Climate Change Group, The World Bank*



Output 2: Risk information generated for impact-based forecasts and early warnings

Through national-level Output 2, the CREWS initiative supports improvements to risk information to guide early warning systems and for the development of impact-based forecast and warnings, namely those that inform on the potential impact of an extreme event rather than solely on the occurrence of the event. This output contributes to the “disaster risk knowledge” element of early warning systems.

Progress highlights

- In the Democratic Republic of Congo, mapping of flood hotspot areas in Kinshasa was carried out through the Open Cities Initiative, while flood early warning systems and services training was provided to national meteorological services, local government and communities. Also, data archiving training was provided to staff of the government’s hydromet services, Mettelsat, by the Institut National des Archivages du Congo to strengthen safeguarding of the country’s hydrometeorological data. The Institut Hydrométéorologique de Formation et de Recherche in Algeria was identified to develop a long-term training plan for MettelSat.
- In Fiji, the Fiji Flash Flood Guidance System (FFGS) was implemented. It improves the quality and lead-time of flash flood threat and risk products by up to 36 hours in advance. This included radar hydrology training for seven Fiji Met Service staff members and operational training for five staff, completed at the Hydrological Research Centre in San Diego, California.
- In Mali, 48 people received start-up training in support of the West African Coastal Observation Mission.
- In Tuvalu and Kiribati, progress has been made to provide a new impact-based forecast and early warning system for coastal inundations, also known as storm-surges. Forecasts are benefitting from the development of wave models using data provided by wave buoys and pressure sensors. Vital data for model simulation and inundation forecasting was obtained through a bathymetry survey and LiDAR topography for Tuvalu, in collaboration with the UNDP Tuvalu Coastal Adaptation Project. A satellite bathymetry for Kiribati was also conducted, with the data to be used for offshore and coastal inundation forecasting models.
- In the Pacific Islands region, nearly 70 participants from the NMHS and national disaster management offices of 13 island countries participated in the

first-ever regional training on impact-based forecast and warning systems, and developed an action plan to advance this within their respective country. A regional training was also held on new and emerging information technologies used by early warning systems, to ensure long-term sustainability.

- In the Southeast Asia region:
 - Forty forecasters and hydrologists responsible for disseminating forecasts and warning to their communities were trained on severe weather and flash flood forecasting, including multi-hazard impact-based forecasts and warnings. Participants included 24 men and 16 women, with 75% from Lao People’s Democratic Republic, where the event was held, and 25% from other Southeast Asia countries.
 - NMHS experts from 14 Association of Southeast Asian Nations (ASEAN) countries participated in a five-day capacity building, knowledge/data sharing event – the Second Workshop on ASEAN Climate Data, Analysis and Projections. This was held in Singapore and attended by 43 participants who were trained on the use of ClimPACT2. This supports improved sector relevant extreme indices towards enhancement of estimates and model assessments of climate change variability and extremes.

More examples of CREWS impacts available at: www.crews-initiative.org/impacts.

CREWS has proven to be a powerful mechanism to help Least Developed Countries and Small Island Developing States adapt to climate change and the growing number of weather-related disasters. CREWS has worked very effectively, and with low administrative costs. Due to this and the fruitful cooperation between the three Implementing Partners, we have already been able to assist 44 countries. We are now pleased to also target resources to Afghanistan, Chad and Togo. WMO is grateful for the financing partners of CREWS and look forward to additional contributions to support countries that are vulnerable to the impacts of climate change, and that have limited early warning systems.



Petteri Taalas, WMO Secretary-General



Photo credit: UNICEF/ZAK

Output 3: Information and communication technology strengthened

Through national-level Output 3, the CREWS initiative strengthens information and communication technology, including through the adoption of common alerting protocols. This output contributes to the “warning dissemination and communication” element of early warning systems.

Progress highlights

- In Afghanistan, assessment of the drought early warning system was carried out, while significant advances were made on an innovative initiative to build hydromet stations using 3D printing technology. This work builds on an initial USAID / WMO project and links to broader engagement by the World Bank.
- In Burkina Faso, training of two experts from the Burkina Faso National Water Resource Management Service on hydrological data management and analysis software was conducted.
- In Chad, agreements were progressed with the French Research and Development Institute, the French Centre for Agricultural Research for Development, the French Centre for Space Studies and national mobile phone operators to ensure optimal use of remote sensing techniques for monitoring of rainfall and runoff.
- In Lao People’s Democratic Republic, a two-year license agreement was established for the supply of European Centre for Medium-range Weather Forecasts products, which has strengthened forecasting capacities.
- In Niger, hydromet database training was provided to staff from the national hydrological service, while capacity building was also carried out in support of broader weather, water and climate services.
- In Papua New Guinea, further assessment of national drought forecast capabilities was conducted. Based on input from stakeholders, recommendations for improvement of the available drought forecasts products have been produced.
- In the Pacific Islands region:
 - An online certificate training course on the common alerting protocol was developed and successfully launched, supporting experts across the Southeast Asia region.
 - The first-ever Communication Mana Class was held to train the directors and senior staff of NMHSs across the region, on using social media (e.g. Facebook, Twitter), radio, television and other media types to deliver natural disaster messages and information to the public.
 - Regional improvements to NMHSs’ online information dissemination capacities have advanced, including the launch of the Cook Islands met service’s website. Also, assessments were carried out on the capacity for the NMHSs of the Federated States of Micronesia, Marshall Islands, Niue and Palau to host and manage websites and traditional knowledge databases.

Gender-specific technical capacity building activities are captured under Output 6 – Gender.

More examples of CREWS impacts available at: www.crews-initiative.org/impacts.



Disasters affect everyone...but not everyone equally. The Sendai Framework for Disaster Risk Reduction is a people-centred global blueprint that sets out how Member States, together with their publics can reduce risk and build resilience, especially for the most vulnerable. Location, age, gender, disability all greatly affect the choices people have to anticipate, prevent and mitigate risks. We know early warning reduces loss of life and livelihoods when disasters occur, so increasing the availability of and improving access to early warning systems is critical – for all people everywhere, but particularly for those most at risk. CREWS is a valuable partnership in driving inclusive progress against the global targets of the Sendai Framework.

Mami Mizutori, UN Assistant Secretary-General and Special Representative of the Secretary-General for Disaster Risk Reduction



Output 4: Preparedness and response plans strengthened and accessible

Through national-level Output 4, the CREWS initiative supports capacity building and institutional cooperation around standard operating procedures to generate, communicate, prepare for and act on warnings as an integral part of disaster preparedness and response plans. This output contributes to the “preparedness and response capabilities” element of early warning systems.

Progress highlights

- In Burkina Faso, new sand and dust storm advisories and sub-seasonal climate prediction early warning forecasts were launched, reaching one million people in the country’s northern region. This included three pilot villages in which farmers were supported to apply early warning forecast information to their agricultural activities.
- In the Democratic Republic of Congo, development of a flood early warning system in the pilot urban watershed of N’Djili in Kinshasa advanced considerably, including the completion of the flood risk assessment and identification of selected future scenarios. (See additional information under Output 2).
- In the Pacific Islands region, a community-based early warning system was developed for communities across the Federated States of Micronesia, Palau, Republic of the Marshall Islands and Niue. Additionally, community-based early warning system and disaster risk reduction capacities were advanced in 14 Pacific Island countries through policy development, establishment of response mechanisms and technical training. This included the training of 32 facilitators, at least two per state, on skills related to community disaster plan development and management. This mechanism enables communities to be proactive in preparing their response plans and readiness when extreme weather events occur. It also enables traditional climate and weather knowledge to be collected and applied.

More examples of CREWS impacts available at:
www.crews-initiative.org/impacts.

We must move from talk to action. The level of greenhouse gases in the atmosphere is higher than it has ever been. Climate change is already happening. And those suffering the most are the developing countries who, to crown it all, are the ones that have contributed the least to this situation. That is why it is important that affected countries get proper weather forecasts, so they are not caught totally unprepared when droughts or floods occur. If they know, for example, that a storm is on its way, with heavy rainfall, they have a much better chance of being able to prepare for it and can perhaps also receive timely assistance.

Gerd Müller, German Federal Minister for Economic Cooperation and Development



Output 5: Awareness on early warning improved

Through national-level Output 5, the CREWS initiative supports the development of knowledge products and awareness programmes on early warnings and contributes to the “preparedness and response capabilities” element of early warning systems.

Progress highlights

- In Burkina Faso, a mid-term review of the early warning system relevance, effectiveness, efficiency, impact and sustainability was conducted and is now available to advance knowledge. (See additional information under Output 4).
- Experts from the Democratic Republic of Congo and Burkina Faso were supported to present their CREWS-funded early warning initiatives to an audience of more than 600 experts and practitioners at the *Understanding Risk West and Central Africa* conference held in November 2019 in Cote d’Ivoire. Experts from Chad were also funded to participate, to expand their knowledge.
- Production and distribution of a new video on the Flash Flood Guidance System (FFGS) was supported, which includes testimonials from countries using the system. FFGS is an interactive system for use by meteorological and hydrological forecasters throughout the world, and a public benefit effort on behalf of its development partners.
<https://youtu.be/5blgMMx1eOw>
- In the Pacific Islands region, a new animated video to prevent loss of life and property during coastal flooding in Pacific Island communities was produced and distributed. It includes life-saving tips on understanding early warning signs, how to access emergency alerts, what to expect during coastal flooding, seeking safe shelter, responding to dangers and staying informed. <https://youtu.be/sND3spqgsc0>

More examples of CREWS impacts available at:
www.crews-initiative.org/impacts.

CREWS project will help to shift Niue Met Service’s works to sectors and communities, including review of existing mechanisms and policies with regards to disaster risk reduction and early warning system. This will also provide opportunity to form partnership with the Niue boys and girls brigade, the National Disaster Management Office, and the women’s group, with the aim increasing communities’ engagement and awareness on meteorological and hydrological data and information.

Rossy Pulehetoa Mitiepo, Director of Niue Meteorological Service
in her opening remarks during the launch of the CBEWS component of the CREWS Pacific SIDS Project in Niue in 2019





Output 6: Gender-sensitive capacity-building programmes initiated

Through national-level Output 6, the CREWS initiative supports gender-sensitive training and the provision of capacity building programmes for women, as gender influences the way people access, process and respond to information and warnings. The CREWS initiative recognizes that women's empowerment is fundamental for building resilience and through this output contributes to the "preparedness and response capabilities" element of early warning systems.

Progress highlights

- In the Democratic Republic of Congo, women in Kinshasa were trained to conduct and collect household survey information for input into the mapping of exposure and vulnerability.
- In Mali, 90 women leaders were trained on prevention, disaster management and early warning through two regional training events.
- In Niger, terms of reference were developed to sensitize women on early and rapid warning systems in Niamey and 50 locations around the country.
- In the Caribbean region, the mapping of gender actors and initiatives was completed, and four national training and consultation events were held on the topic of "gender and early warning systems", with the results used to feed the regional early warning system diagnostic and strategy development.
- In the Pacific Islands region, 35 women from 13 islands, representing meteorology, hydrology and climatology received leadership training, and took part in regional discussions on early warning systems.
- In the Southeast Asia region, 16 women forecasters and hydrologists, who are responsible for disseminating forecasts and warnings to their communities, were trained on severe weather and flash flood forecasting. This included multi-hazard impact-based forecasts and warnings, and was held in Lao People's Democratic Republic.

More examples of CREWS impacts available at:
www.crews-initiative.org/impacts.

Gender and vulnerable group inclusion is a game changer in early warning and climate resilience. In many disasters, when sex and age differentiated data is collected, we see that certain groups have significantly higher mortality and affectation rates in comparison to the overall population. It is important to recognize that due to the varied socio-cultural differences, disasters affect women, girls, men and boys in different ways. By understanding this, we can better target actions, reach the entire population with early warnings, and improve the results of early warning systems and climate action.

Maria Kontro, Disaster Risk Reduction Advisor for the Caribbean Region, UNDRR





Photo credit: World Bank/Vlad Sokhin



Photo credit: FAO/IFAD/WFP/Luis Tato

FOCUS

Gender and vulnerable groups in early warning systems

Extreme events do not affect men and women, or boys and girls, equally. In fact, on average, natural hazards kill more women than men, and kill women at a younger age than men – and the stronger the disaster, the worse it gets¹.

Gender-responsiveness, therefore, is a gamechanger in early warning and climate resilience. By understanding this, we can better target actions, reach the entire population with early warnings, and improve the results of early warning systems and climate action.

The early warning and climate resilience actions that do not explicitly consider gender are likely to increase mortality, marginalization and the poverty traps that already exist in the society.

The Sendai Framework for Disaster Risk Reduction, through its global Target G, calls on countries and regions to “Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030”, while recognizing the importance of gender and participation of different groups of the society.

Governments are now beginning to realize the importance of gender responsiveness when disasters occur. In the aftermath of the 2009 Typhoon Ondoy and Tropical Storm Pepeng, the Government of the Philippines passed the 2010 Philippines Disaster Reduction and Management Act. It requires the government to “ensure that disaster risk reduction and climate change measures are gender responsive.” It also requires the inclusion of the Gender Development Office on newly formed Local Disaster Risk Reduction Management Committees².

The CREWS Steering Committee decided that all CREWS investments need to adopt a gender-responsive approach. In doing so, it identified the following aspects of the four pillars of an early warning system, and to ask the following related questions³:

- **Disaster risk knowledge:** Who is most at risk? How do gender-differentiated roles, vulnerabilities and social norms determine behaviour and vulnerability?
- **Monitoring and warning service:** Who has access to the information needed to generate early warnings? Do women, men and children interact with their world differently – can this influence their access to different types of information that serves monitoring and warning services?
- **Dissemination of meaningful warnings to those at risk:** How and to which population groups early warnings are issued? Do women, men and children access, process, interpret and respond to information in different ways? Are different socio-cultural groups connected to different social networks and do they have different communication strategies?
- **Preparedness and response capability:** How can different groups contribute most effectively in the response and recovery from disasters? Is the whole population presented when collecting information during needs assessments, or only the heads of households? How does this influence on whose needs are being responded to?

Learn more about how the CREWS initiative ensures gender-responsiveness in its work to expand access to early warning systems in LDCs and SIDS, read our CREWS Impact Feature on work being carried out across the Caribbean, visit www.crews-initiative.org/impacts.

¹ Neumayer, Eric & Plümer, Thomas. (2007). The Gendered Nature of Natural Disasters: The Impact of Catastrophic Events on the Gender Gap in Life Expectancy, 2002-1981. *Annals of the Association of American Geographers*. 10.1111 .97/j.8306.2007.00563-1467.x.

² Integrating Gender Issues in Disaster Risk Management Policy Development and in Projects, World Bank

³ UNDRR Regional Office for the Americas and the Caribbean, 2019.

PROGRESS AGAINST REGIONAL LEVEL OUTPUT

Regional Output: Regional capacities for early warning strengthened

Through its Regional Output, the CREWS initiative supports increased institutional and human capacities at regional WMO and intergovernmental organizations. This output addresses the early warning elements “detection, monitoring, analysis and forecasting of the hazards and possible consequences” and “disaster risk knowledge”.

Progress highlights

- In the Caribbean region:
 - The Caribbean early warning system regional diagnostic was drafted, and a consultation process was carried out. The letter of agreement for project implementation is now under review by the Caribbean Meteorological Organization, the regional implementing partner. This will include the development of eight national strategic plans and model meteorological bills, and two national meteorological bills. Additionally, the Regional Sub-Management Team Meeting was held for the Severe Weather Forecasting Demonstration Project-Eastern Caribbean.
 - The first regional workshop on definition of roles and responsibilities among the early warning system actors was held in December 2019.
 - Expert training in the “science to services interface” was provided by the UK Met Office to 50 staff members of 11 NMHSs from Commonwealth Caribbean Countries. Participants identified available climate services for the Caribbean on long-term climate change timescales, and co-developed good practices for communicating climate risk at a national scale.
- In the Pacific Islands region:
 - The long-term strategic plan is now complete for strengthening the capacity of the Regional Specialised Meteorological Centre (RSMC Nadi), within the Fiji Meteorological Service. This will enable RSMC Nadi to support other Pacific Islands and enhance the capacity of NMHSs of Pacific Island countries and territories to provide impact-based forecasts of extreme weather events such as floods, droughts, cyclones and storms.
 - The 5th Pacific Islands Climate Outlook Forum was held, resulting in the Regional Statement on the Climate 2018/2019 and the Tropical Cyclone Outlook for Oct-Dec 2019. The 50 participants included 18 women and 32 men from 15 NMHSs, as well as agricultural sector representatives from six countries, in order to strengthen meteorology-agriculture sector collaboration.
- In the West Africa region:
 - Technical experts were trained to support the Senegal National Meteorological and Civil Aviation Agency (ANACIM) for severe weather forecasting; ANACIM and the Specialised Institute of the Permanent Interstate Committee for Drought Control in the Sahel (AGRHYMET) for flood forecasting; AGRHYMET for regional climate coordination; and ANACIM, AGRHYMET and the West African Coastal Observation Mission for climate assessment and dataset, hydromet and climate extreme database.
- In the Southeast Asia region:
 - An assessment of multi-hazard early warning systems in Thailand, Cambodia, Lao People’s Democratic Republic, Viet Nam and the Philippines was carried out by the Regional Integrated Multi-Hazard Early Warning System. Information on capacities and gaps was shared, towards enhancement of capacities across the region.
 - The development of the Southeast Asia Flash Flood Guidance System was advanced at a regional planning meeting held in Viet Nam, during which stakeholders considered local data requirements and discussed a work plan for implementation. Also, forecasters from partner countries participated in training for radar quality assurance and quality control, and radar hydrology.

*Additional gender-specific regional initiatives are highlighted in **Output 6** results.*

More examples of CREWS impacts available at: www.crews-initiative.org/impacts.

The CREWS project is so important because we are talking about the most vulnerable of the vulnerable. CREWS funding has helped local meteorological services provide weather forecasts and early warnings in simple ways which can be easily understood by local communities.



Kosi Latu, Director-General of the Secretariat of the Pacific Regional Environment Programme

DRIVING INNOVATION: IDENTIFYING, CAPTURING AND SHARING PRACTICES

The CREWS initiative, its Implementing Partners and its Steering Committee Members are committed to supporting innovation through transformative development operations.

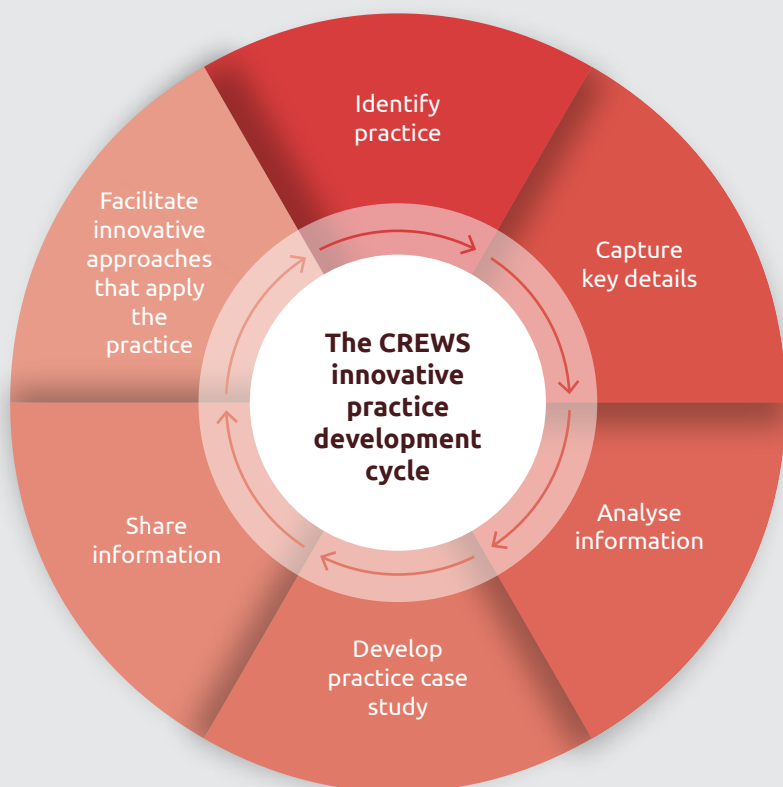
As part of this commitment, CREWS began an initiative in 2019 to identify, capture and share innovative practices through a systematized process. The sharing of information will create a knowledge base to strengthen CREWS country investments and those of the larger global community engaged in improving weather and climate services and early warning systems.

The innovative practices currently being analysed draw on the experiences of CREWS projects as well as other numerous initiatives underway across the globe to strengthen early warning systems. Through this

process, the analyses draw from a well-established body of knowledge on what constitutes an effective early warning system, and distil key elements for adapted application, expansion and collaboration to facilitate innovative approaches.

The sharing of these innovative practices will also address the demand from countries and practitioners to strengthen the community of practice around weather, climate and hydrological service for early warning systems – in order to maximize the exchange and application of innovative approaches to address challenges affecting national institutions.

Currently three such innovative practice analyses are in development, with the results to be released in 2020.



CREWS is increasingly relevant because of the growing impact of climate change especially on the most vulnerable. It is clear we are in a race against the clock.

Brigitte Collet, Ambassador for Climate, France



TOWARDS A CONCERTED APPROACH: MEASURING EARLY WARNING ACCESS AND EFFECTIVENESS, AND THE IMPACT OF CREWS

While the results of CREWS projects are measured against the monitoring framework contained in the [CREWS Operational Procedures Note No2 Monitoring and Evaluation](#), metrics are also needed to systematically measure the overall higher-level impacts of the CREWS initiative and the related access and effectiveness of early warning systems in LDCs and SIDS.

This requires LDCs and SIDS to have a level of reporting capacity. Currently, the number of LDCs and SIDS that report on Sendai target G is low, at just 23% of LDCs and 3% of SIDS, as per UNDRR 2019 figures.

Recognizing this reporting capacity gap for LDCs and SIDS, the CREWS Steering Committee initiated the development, in 2019, of a set of core programme indicators, which:

- Support a concerted approach by countries, the CREWS Trust Fund, and other international partnerships to assess the effectiveness of early warning systems and monitor progress of related investments.
- Align with indicators adopted by Member States for relevant global goals and targets, and specifically with those used by countries to measure life and economic loss due to disasters, and to measure

access to early warning systems and risk information (SDG 1.5 and [Sendai Framework Targets, A, B and G](#)).

The CREWS Steering Committee has also recognized the need to further build capacity for national institutions in LDCs and SIDS to be able to assess the effectiveness of their national early warning systems.

CREWS CORE PROGRAMME INDICATORS EXPLAINED

In order to measure the effectiveness of, and access to, early warning systems for severe weather events in LDCs and SIDS, a limited number of metrics have been identified to systematically assess progress.

These draw on the extensive work and expertise of the CREWS initiative's Implementing Partners – WMO, World Bank / GFDRR, UNDRR – together with the experiences and needs of CREWS Country Partners. The indicators will measure progress in the key elements of the early warning value chain including monitoring, forecasting and issuance of warnings, understanding the risk, communicating and being prepared to act on warnings. Each one will be measured against a 2015 baseline across all LDCs and SIDS, and for each country with a CREWS investment.



Photo credit: UN

Benefits

Examples

1. LOSS OF LIFE



The number of deaths and missing persons in LDCs and SIDS attributed to hydrometeorological events, per 100 000 population.

- Measured as a subset of Sendai Target “A” covering only hydrometeorological hazards.
- Provides the long-term metric against which the efficiency of early warning systems is measured in countries.

- Between 1998 and 2018, more than 500,000 people lost their lives due to extreme weather events⁴. Developing countries represent 90% of all deaths.⁵
- The lower the level of human development, the more deadly the disasters based on loss of life per recorded event based on 20 years of data.⁶

2. FORECASTING AND WARNING CAPACITY



Hazards for which forecasting and warning services are available in LDCs and SIDS

- Informs on forecasting and warning capacities developed for new types of hazards through the CREWS initiative.
- Potential to provide information on extreme events in LDCs and SIDS for which forecasting and warning capacity are not available.

- Early warning system for flash floods in Fiji.
- Coastal storm surge predictions for Kiribati and Tuvalu.
- Seasonal forecasts in Papua New Guinea.
- Sandstorm advisories for Burkina Faso.

3. ACCESS TO EARLY WARNING



The number of people living in areas covered by forecasts and warnings for a given hazard, and to enhance the gender-responsiveness of this process.

- Provides an estimate of the number of people, preferably disaggregated by gender, accessing a given forecast and warning service.
- Complements the usual way to account for the number of people accessing early warnings which is typically done through surveys.
- Emphasizes the leadership role of women in developing these systems to ensure women and girls access early warning services. These efforts will need to be accounted for as well.

- One million people in Burkina Faso have access to advanced climate advisories, which are broadcast regularly by local radio stations.
- More than 900,000 people accessing flash flood warnings in Fiji.
- Hundreds of thousands of people accessing sandstorm advisories in Burkina Faso.
- More than 8.5 million people accessing early warnings in Papua New Guinea.

4. USE OF RISK INFORMATION



The number of LDCs and SIDS that have generated risk information that enhances their early warning system

- Identifies data and information generated by the projects regarding the physical monitoring of the hazards and the socio-economic vulnerability of populations at risk.
- Measures the availability of data platforms put in place that supports decision making (risk forecasting and monitoring and distributing of warnings)
- Supports risk information and related tools required to obtain impact-based forecasts and early warnings.

- In Niger, household surveys identify neighbourhoods at risk of flooding (geographical coordinates, type of buildings, number of people in the household, type of cultivated area).
- In Tuvalu, a complete bathymetry survey and LiDAR topography has been carried out providing data needed for model simulations and inundation forecasting. Similar data has been obtained by satellite for Kiribati.
- In DRC, a flood model has been developed for two watersheds.

5. CAPACITY TO DISSEMINATE WARNINGS



The number of LDCs and SIDS communicating warnings through common alerting procedures, and the number of households and individuals with access to and use of information communication technology in LDCs and SIDS.

- Measures digital mobile connectivity across LDCs and SIDS, and the capacity of countries to disseminate warnings through mobile phones, in addition to other methods including radio.
- Uses the Common Alerting Protocol (CAP), an international standard format for emergency alerting and public warning, which systematizes the communication of warnings and maximizes their outreach.

- Number of LDCs and SIDS with operational Common Alerting Protocols in 2019 remains low at 18% (up from 15% in 2015).
- Number of LDCs and SIDS where CREWS has initiated investments that have operational CAPs in 2019 is equally low at 16% (up from 4% in 2015)
- The digital gender gap remains significant, with 24% of men compared to only 13% of women having connectivity in LDCs.⁷

6. CAPACITY TO PREPARE FOR AND RESPOND TO WARNINGS



The number of LDCs and SIDS using standard operating procedures to issue warnings for forecasted hazards.

- Measures where standard operating procedures are applied for effective delivery of early warning systems.
- Benefits further development, through cooperation with partners working on early action.

- Niger adopted a national early warning Alert Code by Presidential Decree.
- Followed by training of governors, prefects, mayors in the dissemination of alerts in four regions and the district of Niamey.

⁴ Global Climate Risk Index 2020

⁵ UNDRR

⁶ Human Development Report, UNDP 2020

⁷ ITU, *Facts and Figures 2019*

SCALING UP THROUGH PARTNERSHIPS

The CREWS initiative actively engages with and supports a growing number of international initiatives:

ALLIANCE FOR HYDROMET DEVELOPMENT

Through its Implementing Partners, the CREWS initiative contributes to the Alliance for Hydromet Development, launched in December 2019 at the Global Climate Change Conference (COP25). Its twelve founding international humanitarian and development organizations have collectively committed to ramp up action to help developing countries deliver high-quality weather forecasts; early warning systems, taking advantage of CREWS; and hydrological and climate services. Known in short as “hydromet” services, these underpin resilient development by protecting lives, property and livelihoods. CREWS has committed to contributing its growing body of knowledge, data and metrics to the Alliance to inform the work of its members.

GLOBAL COMMISSION ON ADAPTATION

The Global Commission on Adaptation was launched in October 2018. It is hosted by the Global Center on Adaptation and act as a catalyst for large-scale transformative adaptation action and partnerships. CREWS contributed to the work of the Commission and, in particular, to its flagship report produced in 2019 in the lead-up to the UN Secretary-General’s Climate Action Summit.

GREEN CLIMATE FUND

The Green Climate Fund (GCF) and CREWS share the common objective of increasing resilience in developing countries and reducing climate and disaster risks. The CREWS initiative’s mission contributes to the overall Adaptation Strategic Impact area of the GCF. GCF’s result management framework emphasizes early warning systems and climate information as one of the backbones of its resilience and adaptation investments. While no formal agreement exists between the secretariats, they communicate regularly and exchange information on the complementarity of each’s portfolio and collaboration opportunities. Two CREWS Implementing Partners have formal agreements with the GCF:

- The World Bank is an accredited entity of GCF and as of December 2017 the portfolio of hydrometeorological services under the GCF totals approximately US\$ 50 million, with a number of additional countries in the pipeline.

- WMO provides technical expertise to the GCF Secretariat to develop the concept, methodology and implementation approach to articulate the climate rationale of all GCF-funded projects and activities. The climate rationale provides the scientific underpinning for evidence-based climate action decision making and the theory of change of all activities funded by the GCF.

As part of this, in working with countries on projects, CREWS Implementing Partners promote alignment with ongoing or potential GCF financing mechanisms, and related countries’ readiness programmes, regional and national structure dialogues, project preparatory facility and funding proposals.

INSUREILIENCE

The InsuResilience Investment Fund promotes the development of climate risk insurance products by providing debt and equity, along with technical assistance, to qualified insurers, re-insurers and companies in the insurance value-chain in developing countries. In 2019, the InsuResilience and CREWS secretariats decided to strengthen their operational cooperation and to initiate a study to analyse the weather and climate data needs, availability, accessibility and reliability in a selection of countries in which both InsuResilience and CREWS have investments in the context of the requirements to facilitate the penetration of risk financing and insurance solutions.

RISK-INFORMED EARLY ACTION PARTNERSHIP

Several CREWS Contributing Members have become members of the new Risk-informed Early Action Partnership (REAP) launched in September 2019 in conjunction with the UN Climate Action Summit. REAP brings together those working on early warning and early action, and focusing on the communities most at risk from climate shocks. This partnership is designed to drive a systemic shift towards anticipatory action that will save lives and protect livelihoods. CREWS will strive to contribute to REAP through its country practices, knowledge, metrics and data.

By 2025, REAP seeks to realize US\$ 500 million in investments for the expansion of early warning systems, in order to provide services to one billion people across 50 countries.





GLOBAL RECOGNITION FOR EARLY WARNING SERVICES

The CREWS initiative contributed to several global-level events in 2019 to promote accelerated action on early warning systems and was recognized for its critical work to expand climate risk and early warning systems and services in LDCs and SIDS:

CREWS AT THE UN SECRETARY-GENERAL'S CLIMATE ACTION SUMMIT

The important finance mechanism role of CREWS was acknowledged at the UN Secretary-General's 2019 Climate Action Summit, in September 2019. This was upon the launch of a new global REAP partnership, which has noted that it will "build on the work of CREWS".

CREWS was also recognized by the Global Commission on Adaptation in its new report, *Adapt Now: A global call for leadership on climate resilience*, launched at the summit. In the report, CREWS is highlighted as a case study in financing expanded access to early warning systems.

Also, CREWS contributed its knowledge and expertise to consultations leading up to the summit through the development of a white paper advocating for climate services and early warning systems.

CREWS AT THE UN CLIMATE CHANGE CONFERENCE

CREWS participated in several events at the UNFCCC Climate Change Conference (COP25) in December 2019 and hosted a high-level event at the Benelux / European Investment Bank Pavilion. This included the participation of Carole Dieschbourg, Luxembourg Minister of the Environment, Climate and Sustainable Development, and Chairperson of the CREWS Steering Committee; Ingrid-Gabriela Hoven, Director General of the Federal Ministry for Economic Cooperation and Development, Germany; Brigitte Collet, Ambassador for Climate Change, France; Petteri Taalas, WMO Secretary-General; Mami Mizutori, Special Representative of the UN Secretary-General for Disaster Risk Reduction; and Bernice van Bronkhorst, Global Director, Climate Change Group, World Bank.

Germany took the occasion to announce a €10 million contribution to the CREWS Trust Fund, on top of its initial €3 million contribution in 2016.

CREWS AT THE SECOND MULTI-HAZARD EARLY WARNING CONFERENCE

Achievements of the CREWS Initiative were recognized by the Second Multi-Hazard Early Warning Conference (MHEWC-II) in its official communiqué, which recognized, "The multi-donor Climate Risk and Early Warning System (CREWS) Initiative which has assisted countries in the Caribbean, in Africa and in the Pacific in strengthening their early warning systems".

Under the theme *Early Warning and Early Action towards Sustainable, Resilient and Inclusive Societies*, participants also agreed to "Commit to the strengthening of multi-hazard early warning capacities at the national level through sharing of good practices, leveraging capacities of neighbouring and supporting countries and capacity development projects such as under the CREWS Initiative...".

CREWS played an important role at the May 2019 event, serving on the event's Steering Committee and holding a special side event on the topic of "Country practices, people-centred early warning", which brought together leading experts to advance early warning systems and services for SIDS and LDCs.

The knowledge gained from the seasonal forecasts coupled with information on the climate of our village makes it possible to determine the best planting dates. We also learned what seeds to select depending on when the rainy season starts.

Farmer in Burkina Faso



CREWS VALUE PROPOSITION



› UNIQUE

A financing mechanism that builds sustained institutional capacity driven by countries and supported by the expertise and specialist networks of its partners.

› PEOPLE-CENTRED

Local organizations are listened to and engaged so that investments are driven by the needs of end-users.



› SOLUTION-ORIENTED

Good and innovative practices are applied and shared continuously across national and regional projects.

› MULTIPLIER

Country portfolios promote a favourable environment for, and leveraging of, effective additional financing.



› GENDER-RESPONSIVE

CREWS recognizes women's empowerment as fundamental for building resilience, and that gender influences the way people access, process and respond to information and warnings.

› PROMOTES COHERENCE

Programming considers existing projects and other international partner initiatives to ensure value-added to the national context and needs.



PARTNERS WORKING TOGETHER

The Implementing Partners of the CREWS initiative – WMO, the World Bank Group / GFDRR and UNDRR – work cooperatively and complementary to each other, with each bringing a unique set of expertise and experience. Through this strong implementation process, and with the direct support of contributing partners to the CREWS Trust Fund, they are realizing significant results.

World Bank Group / GFDRR

Through its Action Plan on Adaptation and Resilience, the World Bank Group has committed to substantially increase financing for quality forecasts, early warning systems and climate information services in at least 30 additional countries. As a CREWS Implementing Partner, the World Bank Group / GFDRR collaborates with WMO and UNDRR to increase access by vulnerable communities around the globe to live-saving early warning systems and services.



WMO

WMO's vision 2030 is a world where all nations are more resilient to the socio-economic consequences of extreme weather, climate, water and other environmental events. To achieve this, WMO prioritizes closing the capacity gap by enhancing service delivery of developing countries, in particular LDCs and SIDS, to ensure the availability of essential information and services needed by governments, economic sectors and citizens. WMO's engagement in CREWS contributes to meeting these goals by leveraging the technical expertise of its Members in providing enhanced warning services with a seamless approach for climate and weather events.



UNDRR

UNDRR developed the Sendai Framework Monitor in 2018 as the tool to support countries to measure their progress against Sendai Targets, including Target G "Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030." UNDRR provides technical guidance inter alia for minimum data standards and methodologies.



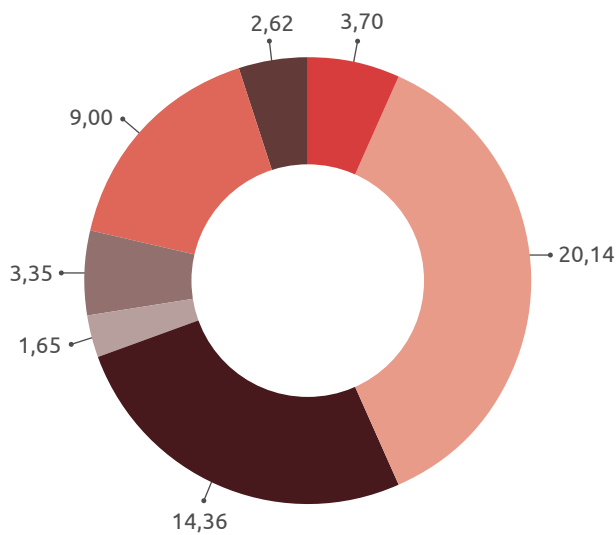
REPORTING OF THE CREWS TRUST FUND

FUND CONTRIBUTIONS

As of 31 December 2019, CREWS Trust Fund effective (signed) contributions total US\$ 54.82 million, as per the breakdown below. Of this, US\$ 43.59 million has been deposited into the CREWS Trust Fund, with approximately US\$ 11.23 million contributed by Germany to be deposited in instalments from 2020 to 2022.

CREWS Trust Fund Signed Contributions

In US\$ millions, as of 31 December 2019



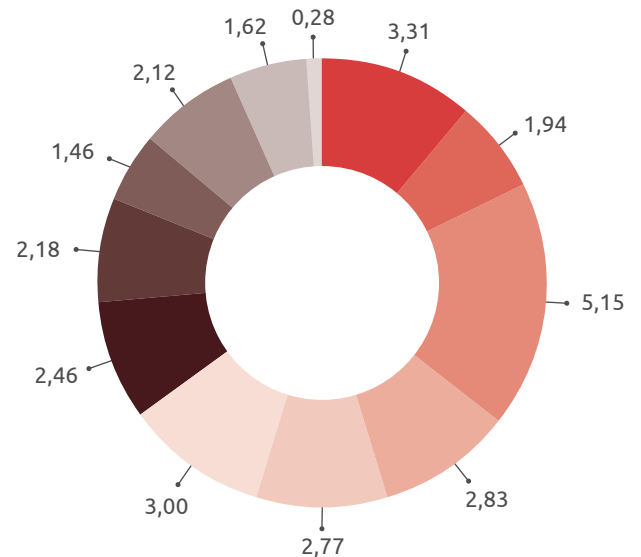
- Australia
- France
- Germany
- Luxembourg
- Netherlands
- Switzerland
- United Kingdom

PROJECT FUNDING

As of 31 December 2019, the CREWS Trust Fund has provided US\$ 37 million in direct project funding, supporting 44 countries. This represents 85% of funds deposited by year end, 92% of funds deposited as of September 2019 – demonstrating the strength of CREWS as an effective finance mechanism.

Funding Decisions by Project

In US\$ millions, as of 31 December 2019



- Afghanistan
- Burkina Faso
- Caribbean
- Chad
- Democratic Republic of Congo
- Mali
- Niger
- Pacific Islands Region
- Papua New Guinea
- Togo
- West Africa & Sahel Region
- Global and Administrative

As of 31 December 2019 in US\$ millions

	Total	% of Total
Donor Pledges and Contributions		
Contributions	54.82	100.0%
Pledges	–	0.0%
Total Pledges and Contributions	54.82	100.0%
Cumulative Resources		
Resources received		
Cash Receipts	43.59	78.6%
Investment Income earned	0.66	1.2%
Total Resources Received	44.26	79.8%
Resources not yet Received		
Contributions not yet received	11.23	20.2%
Pledges	–	0.0%
Total resources not yet received	11.23	20.2%
Total Potential Resources (A) (in US\$ millions)	55.48	100.0%
Cumulative Funding Decisions		
Projects	29.10	79.6%
Fees	3.56	9.7%
Administrative Budget	3.88	10.6%
Total Funding Decisions Net of Cancellations (B)	36.54	100.0%
Total Potential Resources Net of Funding Decisions (A) - (B)	18.95	
Funds Available		
Funds Held in Trust with no restrictions	7.72	
Approved Amounts Pending Cash Transfers	–	
Total Funds Available to Support Steering Committee Decisions	7.72	

Note: sub-totals may not add up to due to rounding

For more information visit www.crews-initiative.org or contact us at crewsinfo@wmo.int



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CREWS gratefully acknowledges the contributions of its Members:

CREWS Members



Australia



France



Germany



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Netherlands



Switzerland



United
Kingdom

CREWS Observers



ACP



Canada



European
Commission



Finland



Japan



Mexico



New Zealand



Norway



UNDP



USAID

CREWS Implementing Partners

