



## CREWS PROJECT STATUS REPORT (January - June 2021)

|                                       |  |   |  |
|---------------------------------------|--|---|--|
| <b>1. Project title</b>               | Weather and Climate Early Warning System for Papua New Guinea  | <b>2. Project reference</b>                                   | CREWS/CProj/08/Papua New Guinea  |
| <b>3. Lead Implementing Partner</b>   | WMO  | <b>4. Regional/ National Partners involved in the project</b> | Papua New Guinea National Weather Service (PNG NWS), Australia Bureau of Meteorology (BoM) |
| <b>5. Project Duration/ Timeframe</b> | Oct 2017 - Jul 2022  |   |  |
| <b>6. Reporting focal point</b>       | Robert Stefanski <a href="mailto:rstefanski@wmo.int">rstefanski@wmo.int</a>  |   |  |
| <b>7. Project overview</b>            | <p>In Papua New Guinea, CREWS is building the capacity of the national meteorological agency and strengthens its cooperation with key sectoral ministries, departments and other stakeholders for agriculture, disaster management, energy and infrastructure.</p> <p>Other hazards related to droughts such as frost and bush fires are also indirectly addressed. The project puts in place end-to-end EWS focused on reducing drought, flooding and frost impacts, through improved weather observations, climate data management of historical data, climate data rescue, state-of-the-art seasonal and sub-seasonal forecasting coupled with monitoring and advisories for drought, and a more efficient distribution of alerts and information suitable for decision making at a national and local level. The main focus is on building the capacity of the National Meteorological Service and strengthening its cooperation with key sectoral ministries, departments and other stakeholders working in the above areas to put in place complete systems that deliver warnings and relevant information to end-users. Enhancement of these basic capabilities will be</p> |   |  |

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complemented with support for integration of early warnings into national processes. The project draws on advanced technical expertise from cooperating institutions to ensure access to relevant data, products, tools, training and equipment.

## 8. Progress summary

- Letters of Agreement have been signed with the PNG National Weather Service (NWS, 28 Nov 2018) and Bureau of Meteorology of Australia (BoM, 29 Nov 2018).
- A first mission was held 22-24 November 2018; the Inception workshop for project took place in Port Moresby, PNG on 18-22 February 2019, with the participation of numerous stakeholders from agriculture & food security, disaster risk reduction, energy, health, water and other sectors in PNG; users' feedback on the development of operational Climate EWS for drought in PNG was obtained and recommendations were produced;
- CREWS\_PNG 2<sup>nd</sup> Stakeholders Consultation Workshop was held in Port Moresby, PNG from 22 to 23 October 2019.

During the reporting period




- CREWS-PNG 4<sup>th</sup> stakeholders' workshop (virtual meeting) has been conducted on 16-17 March 2021. Participant from the PNG NWS, BoM and WMO as well as key stakeholders from agriculture, health, DRR, energy, and water sectors highly evaluated the developed experimental Drought Risk Analyser and user-centred I-EWS for drought. The workshop took in account the discussions from the CREWS-PNG 3<sup>rd</sup> stakeholders' workshop and the PNG National Climate Outlook Forum (NCOF) that was held in 19-20 November 2020.
- Responding to the COVID-19 pandemic impact on implementation of the project's activities, and in order to maintain project connections and continuity of stakeholders' feedback, virtual meetings of project implementing partners – the Bureau of Meteorology (BoM), the Papua New Guinea National Weather Service (PNG NWS) and WMO - have been conducted fortnightly. These meetings, though not originally part of the project plan, have proven to be highly beneficial, and will be continued over the entire duration of the project.
- Achievements of CREWS-PNG were presented at WMO event "Strengthening collaboration among National Meteorological and Hydrological Services and WMO centers for effective support to Members through extra-budgetary projects" virtual meeting on 10-12 March 2021.
- The ownership of the vehicle has now been transferred entirely to PNGNWS.
- There has been significant progress in digitizing the climate records under the Data Rescue component of the project. However, the


digitization is about 50 to 60% complete. Staff from project funds have been hired to do this work and discussion are underway to hire more staff.

- Ten-minute Automatic Weather Station (AWS) data for 37 stations for 2009 – 2020 have been transferred from the PNG Remote Sensing Centre (RSC) to PNG Capacity Development Project (PNG-CDP). Meteorological observation data are now stored at BoM and ready for climatological analysis.
- The developed set of the WMO SWCEM products for drought detection and monitoring was further enhanced by improving spatial resolution for the Standardised Precipitation Index (SPI) in coastal areas of PNG.
- A significant milestone has been achieved with enhancing functionality of the WMO Global Producing Centre for Long-Range Forecasts (GPC-LRF) Melbourne portal. The portal is now publicly released and available at <http://access-s.clide.cloud/>. High resolution sub-seasonal-to-seasonal (S2S) climate prediction products from the ACCESS-S and satellite precipitation estimates and derived products from SWCEM are now available to the PNG NWS and used for operational production of climate bulletins, the Early Action Rainfall Watch for PNG etc.
- The development of PNG region-specific Drought Risk Index (DRI) which integrates Drought Hazard Index (DHI), Drought Vulnerability Index (DVI) and Drought Exposure Index (DEI) has commenced. For DHI, BoM team used the SPI and the VHI obtained through the WMO SWCEM. For DVI and DEI, PNG NWS provided BoM team with relevant information (agricultural data, land use data, elevation, household data, etc.) obtained from PNG statistical department and other agencies. Experimental monthly maps of the SPI, VHI and DHI; DVI; DEI; and DRI for all PNG provinces for January, February and March 2021 were produced in ArcGIS.
- Performance of an experimental I-EWS for January, February and March 2021 was tested; progression of staged drought warnings from "DROUGHT WATCH" to "DROUGHT ALERT" and then to "DROUGHT CRITICAL" was observed in a number of provinces in PNG, due to impact of the 2020-2021 La Niña conditions.
- Collaboration with the Australian Centre for International Agricultural Research (ACIAR) was further strengthened. BoM and PNG NWS team members participated in ACIAR workshop held on 29 March 2021; further assessment of national capabilities on drought forecasts was conducted and possible approach to designing the Seasonal Farm Advisory (SFA) for PNG was discussed.

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|--|---|
|  | <ul style="list-style-type: none"> <li>- An experimental set of the SWCEM drought monitoring products and BoM ACCESS-S high resolution S2S climate prediction products for the PNG region are now being produced and provided on a monthly basis to the 'Climate Smart Agriculture opportunities for enhanced food production in PNG' project funded by the Australian Government Department of Foreign Affairs and Trade (DFAT) through ACIAR.</li> <li>- A manuscript which describes verification results of drought detection over Papua New Guinea using satellite-derived products was prepared. After undergoing rigorous internal review process, the manuscript was submitted to <i>Remote Sensing</i> journal (IF 4.509), accepted and published as an open access paper titled "Drought Detection over Papua New Guinea Using Satellite-Derived Products" .</li> </ul> |
|  |   |

## 9. Project Performance

| Interpretation of color coding  |               |  |
|---|---------------|--|
|   | <b>High</b>   | Good progress, on track in most or all aspects of delivery   |
|  | <b>Medium</b> | Moderate progress or on track in some aspects of delivery  |
|  | <b>Low</b>    | Less than moderate or poor progress. Not on track in critical areas of its delivery. Requires remedial attention |

|               | Rate of expenditure   | Rate of delivery  | Alignment of Objectives   |
|---------------|---|---|---|
| <b>Coding</b> |  |  |  |



|                  |   |   |   |
|------------------|---|---|---|
| <b>Narrative</b> | The actuals are at \$485,070 and the obligations at \$893,758, representing in total 84% of the approved \$1,650,000 funding. | With 1.5 project support staff and engagement of specialized experts from BoM and PNGNWS, the rate of delivery is now satisfactory. The initial delays have been somewhat compensated for but COVID-19 has caused other delays. | The project remains strongly aligned to the CREWS objectives. |
|------------------|---|---|---|

## 10. Risk Management Status

|                            |  |
|----------------------------|--|
| <b>Risk Status</b>         | In line with the assessment performed at proposal stage, a risk related to the weak project management capacity in Papua New Guinea National Weather Service (PNGNWS) brings the overall project risk to moderate.   |
| <b>Measures to address</b> | This risk is being mitigated with (i) the hiring of a full time project manager and (ii) support received from BoM and the Government of Australia through the Capacity Development Project (PNGCDP) that aims to increase the reliability of weather observations and to train PNGNWS staff. The PNGCDP project significantly increases the likelihood of success for CREWS PNG project with the provision of one additional full-time staff in the country for several months. |

## 11. Contributions to CREWS Outputs

### 11.1. National Outputs

#### CREWS Output 1: National Meteorological and Hydrological Services' delivery improved, including the development of long-term service delivery strategies and development plans

| Project Outputs  | Overall Project Target | Target for reporting period | Progress by Dec 2020 | Progress by June 2021 |
|--|------------------------|-----------------------------|----------------------|-----------------------|
| 1.1. Integration of national meteorological, hydrological and climate observing systems in OSCAR/Surface, the official repository of | 100%                   | 30%                         | 25%                  | 30%                   |

|      |  |      |     |     |     |
|------|--|------|-----|-----|-----|
|      | surface-based observing stations and platforms metadata of WMO Integrated Global Observing System (WIGOS) - <i>an understanding was reached between the Capacity Development Project (PNG-CDP) funded by the Australian Government (DFAT) to improve wider coverage of observational monitoring stations contributing to improved Numerical Weather Prediction (NWP) capability in the PNG National Weather Service (PNGNWS).</i>  |      |     |     |     |
| 1.2. | Improved climate databases based on Australia Climate Data for the Environment (CLiDE) activities - <i>new observation data from the third party AWS network available for the period from 2010 to present will be prepared in CLiDE format and ingested into CLiDE CDMS, to extend archive of historical climate data for PNG. An implementation plan for improving observational databases for PNG was developed, based on optimal use of CLiDEsc developed by NIWA, a web-based tool that allows users to request data and generate products from a range of environmental observations and variables. Furthermore, through the cooperation of CREWS PNG, CDP and COSPPac, new observational datasets from a third party AWS network operating in the country will be ingested into CLiDE database to extend the current archive of historical climate data for PNG. During the reporting period, agreement to obtain free of charge meteorological observation data for 2009 - 2019 from a third part AWS network run by the PNG Remote Sensing Centre was achieved.</i> | 100% | 20% | 20% | 20% |
| 1.3. | Implementation of enhanced climate database and report on climate data rescue status - <i>With support from the Climate and Oceans Support Program in the Pacific (COSPPac), PNGNWS was able to perform its first ever data rescue activity in 2013. The experience gained from this activity has enabled PNGNWS to start additional data rescue activities based on clear identification of existing gaps and needs in terms of labour, computing infrastructure, archiving space, etc.</i>   | 100% | 30% | 30% | 30% |
| 1.4. | Adapt and implement Australian Climate and Weather Extremes Monitoring System to PNG for basic monitoring of drought, heavy rainfall and frost events - <i>A proposed set of new products for monitoring drought and accumulated heavy precipitation on various</i>  | 100% | 50% | 50% | 50% |

|      |  |      |     |     |     |
|------|--|------|-----|-----|-----|
|      | <i>timescales to be used in operational Climate Extremes Monitoring was developed. During the reporting period, experimental products for monitoring drought and accumulated heavy precipitation derived from satellite observations made available through NOAA and JAXA were produced and demonstrated at the 2nd CREWS-PNG workshop in Port Moresby on 22-23 October 2019.</i>  |      |     |     |     |
| 1.5. | <i>Develop NWP products from Global NWP centres including BOM for use in short-range forecasting - A set of products from the BoM model ACCESS-G (the Australian Community Climate Earth-System Simulator-Global) NWP available for PNG was examined. Availability of new high-quality BoM ACCESS-G operational products complemented by training of staff in products' utilization will contribute to increased NWP capability in the PNG NWS. The selected products were presented at the stakeholders' workshop in October 2019.</i>  | 100% | 60% | 40% | 60% |
| 1.6. | <i>Guidance about how to use sub-seasonal and seasonal forecasts (1week to 3 months) from Global Centers - The need to enhance the availability of sub-seasonal forecast products (from 1 to 4 weeks) and seasonal forecasts (from 1 to 3 months) for PNG was identified, to assist the PNG NWS with ENSO monitoring; During the reporting period, accessibility of BoM ACCESS-S high resolution S2S prediction products for the PNG region through the BoM portal was investigated including forecasts (from 1 week to 3 months) for precipitations, near-surface air temperature, sea surface temperatures (SSTs) and mean sea level pressure (MSLP). A set of improved products for PNG has been made available through a specialized portal; in addition, an implementation plan for enhancing the functionality of the WMO GPCLRF Melbourne portal was developed.</i> | 100% | 50% | 50% | 50% |
| 1.7. | <i>Develop an operational climate early warning system for drought - PNGNWS has been collaborating with NIWA to complement its network of 13 synoptic stations with remote sensing estimates (TRMM, cf <a href="http://www.pngnws.github.io/RainfallMonitoring">www.pngnws.github.io/RainfallMonitoring</a>) and provide enhanced rainfall maps. In consultation with stakeholders, the available WMO SEMDP operational products were examined and a subset of the products including weekly and monthly precipitation estimates, the standardized</i>   | 100% | 50% | 35% | 50% |

|  |      |     |     |     |
|--|------|-----|-----|-----|
| <p><i>precipitation index (SPI), the normalized difference vegetation index (NDVI) and the vegetation health index (VHI) was identified as beneficial for the development of operational Climate EWS for drought. During the reporting period, based on input from users from the Department of Agriculture and Livestock, National Agriculture Research Institute, National Disaster Centre, Climate Change Development Authority, Fresh Produce Development Authority, Conservation and Environment Protection Agency, Cocoa and Coconut Research Institute, Coffee Research Institute, recommendations for improvement of the available drought forecasts products were produced. Key recommendations included: maps are preferable rather than station forecasts, monthly updates of forecasts are considered as beneficial, in addition to seasonal (3-months) updates, among others.</i></p> |      |     |     |     |
| <p>1.8. Equipment including car, observing stations, data concentration, data management, forecasting and service production hardware, based on needs and assessment</p>   | 100% | 50% | 50% | 50% |

### CREWS Output 2: Risk Information to guide early warning systems and climate and weather service developed and accessible

| Project-specific Outputs   | Overall Project Target | Target for reporting period | Progress by Dec 2020 | Progress by June 2021 |
|--|------------------------|-----------------------------|----------------------|-----------------------|
| <p>2.1. Catalog of maps of flood prone areas and flood causes, some to be addressed by SouthEastern Asia Oceanic FFG (SAOFFG)</p>  | 100%                   | 20%                         | 10%                  | 20%                   |
| <p>2.2. Introducing impact-based drought forecasts and risk-informed warnings for improved decision making by the users - <i>During the February 2019 workshop, a concept of impact-based drought forecasts and associated risk-informed warnings was introduced to users, demonstrating how impact-based forecasts could assist with improved decision making. Feedback from stakeholders from agriculture, DRR, energy, health, water and other sectors was collected, and recommendations produced - to</i></p> | 100%                   | 40%                         | 25%                  | 40%                   |



include information on likely impacts into drought and frost warnings.

### CREWS Output 3: Information and communication technology, including common alerting protocol, strengthened

| Project-specific Outputs  | Overall Project Target | Target for reporting period | Progress by Dec 2020 | Progress by June 2021 |
|---|------------------------|-----------------------------|----------------------|-----------------------|
| 3.1. Enhanced multi-channel weather forecast and warnings communication systems - <i>this activity is planned for 2020-2021</i> | 100%                   | 0%                          | 0%                   | 0%                    |

### CREWS Output 4: Preparedness and response plans with operational procedures that outline early warning dissemination processes strengthened and accessible

| Project-specific Outputs   | Overall Project Target | Target for reporting period | Progress by Dec 2020 | Progress by June 2021 |
|--|------------------------|-----------------------------|----------------------|-----------------------|
| 4.1. Pilot testing and evaluation of EWS based on prior stakeholder consultation - <i>this activity is planned for 2020-2021</i> | 100%                   | 0%                          | 0%                   | 0%                    |

### CREWS Output 5: Knowledge products and awareness programmes on early warnings developed

| Project-specific Outputs   | Overall Project Target | Target for reporting period | Progress by Dec 2020 | Progress by June 2021 |
|--|------------------------|-----------------------------|----------------------|-----------------------|
| 5.1. Assessment of user needs including PNG NWS and other stakeholders (through a series of 6 stakeholders' workshops) | 100%                   | 60%                         | 50%                  | 60%                   |

|   |      |     |     |     |
|---|------|-----|-----|-----|
| 5.2. Assessment of observation systems (meteo, hydro, climate) for early warning systems and recommendations on improvements  | 100% | 30% | 30% | 30% |
| 5.3. Assessment of national capabilities on flood / flash flood forecast for urban or near-by areas, some to be addressed by SouthEastern Asia Oceanic FFG (SAOFFG) | 100% | 40% | 30% | 30% |

### CREWS Output 6: Gender-sensitive training, capacity building programmes provided

| Project-specific Outputs  | Overall Project Target | Target for reporting period | Progress by Dec 2020 | Progress by June 2021 |
|---|------------------------|-----------------------------|----------------------|-----------------------|
| 6.1. Training in statistics and basic tools for climate services - <i>this activity is planned for 2020-2021</i>  | 100%                   | 0%                          | 0%                   | 0%                    |
| 6.2. Training in preparing and interpreting the forecasts   | 100%                   | 55%                         | 50%                  | 55%                   |
| 6.3. Training on multi-channel forecast and warnings communication systems  | 100%                   | 40%                         | 30%                  | 40%                   |
| 6.4. Training on climate data management and data rescue  | 100%                   | 55%                         | 50%                  | 55%                   |
| 6.5. Training on OSCAR/Surface  | 100%                   | 0%                          | 0%                   | 0%                    |
| 6.6. Training on climate extremes monitoring and drought forecast   | 100%                   | 40%                         | 30%                  | 40%                   |
| 6.7. Management training  | 100%                   | 20%                         | 10%                  | 20%                   |
| 6.8. Gender analysis to identify opportunities and include specific interventions to promote gender equality in EWS   | 100%                   | 0%                          | 0%                   | 0%                    |
| 6.9. Development and implementation of a gender action plan to ensure gender-specific activities are identified and implemented. The action plan will be discussed at the kick-off meeting and will be integrated into the project work plan. | 100%                   | 0%                          | 0%                   | 0%                    |

## 12. Contributions to CREWS Value Propositions

|   |   |
|---|---|
| <b>Gender Sensitive</b>                   | User requirements have been collected in a gender-disaggregated manner, and a gender action plan is developed to ensure gender-specific activities are identified and implemented.  |
| <b>Multiplier</b>                         | CREWS is building upon a number of parallel projects including SouthEastern Asia Oceanic FFG (SAOFFG), the Capacity Development Project (PNG-CDP) funded by the Australian Government (DFAT) and the Climate and Ocean Support Program for the Pacific (COSPPac)  |
| <b>People-centred</b>                     | The project conducts a rolling assessment of users needs (updated at least once a year for each warning application) and ensures a proper tracking of how user requirements are being fulfilled. All early warning stakeholders are involved among the users.   |
| <b>Promote Coherence</b>                  | The close collaboration with SAOFFG, PNG-CDP and COSPPac ensures capabilities are developed in forecasting, risk assessment, warning dissemination and emergency response with a seamless and integrated approach.  |
| <b>Innovation &amp; Solution-oriented</b> | CREWS supports the development of innovative NWP, climate prediction and agrometeorological services based on weather, sub-seasonal and seasonal prediction (with BoM).   |
| <b>Unique</b>                             | CREWS provides twinning arrangements between PNG NWS with their counterpart in Australia (BoM), with huge potential to continue knowledge exchange and collaboration beyond the project lifetime. In addition, CREWS innovations have the potential to be scaled-up at the national level with the Australia-funded Capacity Development Project (PNG-CDP). |

## 13. Visibility products

- Bhardwaj, J., Asghari, A., Aitkenhead, I., Jackson, M., and Kuleshov, Y., 2021: Climate Risk and Early Warning Systems: Adaptation Strategies for the Most Vulnerable Communities, Journal of Science Policy & Governance (JSPG) 18(2) <https://doi.org/10.38126/JSPG180201>.
- Chua, Z-W., Kuleshov, Y., Watkins, A. 2020: Evaluation of Satellite Precipitation Estimates over Australia, Remote Sensing, 2020, 12(4), 678; <https://doi.org/10.3390/rs12040678>



- Kuleshov, Y., K. Inape, A. B. Watkins, A. Bear-Crozier, Z-W. Chua, P. Xie, T. Kubota, T. Tashima, R. Stefanski and T. Kurino, 2020: Climate Risk and Early Warning Systems (CREWS) for Papua New Guinea, Chapter 9 in book "Drought – Detection and Solutions", (Ed. G. Ondrasek), IntechOpen, London, UK, ISBN 978-1-78984-781-9, DOI: 10.5772/intechopen.85962, pp. 147-168.
- Kuleshov, Y., T. Kurino, T. Kubota, T. Tashima and P. Xie, 2019: WMO Space-based Weather and Climate Extremes Monitoring Demonstration Project (SEMDP): First Outcomes of Regional Cooperation on Drought and Heavy Precipitation Monitoring for Australia and Southeast Asia, Chapter 4, In book "Rainfall - Extremes, Distribution and Properties", (Eds. J. Abbot and A. Hammond), IntechOpen, London, UK, ISBN 978-1-78984-735-2, DOI: 10.5772/intechopen.85824, pp. 51-70.
- Chua Z-W, Kuleshov Y, Watkins AB. 2020: Drought Detection over Papua New Guinea Using Satellite-Derived Products. Remote Sensing, 2020, 12(23):3859, <https://www.mdpi.com/2072-4292/12/23/3859#>.