PACIFIC ISLANDS METEOROLOGICAL SERVICES IN ACTION

A Compendium of Climate Services Case Studies

SPREP
Secretariat of the Pacific Regional Environment Programme

FINNISH METEOROLOGICAL INSTITUTE

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MINISTRY FOR FOREIGN AFFAIRS OF FINLAND

Environment and Climate Change Canada
Environnement et Changement climatique Canada

WORLD METEOROLOGICAL ORGANIZATION

Compendium prepared by SPREP in partnership with WMO and Environment and Climate Change Canada

Compiled by Christina Leala-Gale, FINPAC Project Manager, SPREP

Reviewed by: Dr Netatua Pelesikoti, Director, Climate Change Division, SPREP and PICS Panel Members:
Ofa Fa'anunu (Tonga Meteorological Service)
Simon McGree (BoM)
Neil Plummer (BoM)
Molly Powers-Tora (BoM)
Grant Smith (BoM)
Dean Solofa (SPC)
Andrew Tait (NIWA)
SPREP Climate Change Division staff

SPREP
PROE

Secretariat of the Pacific Regional Environment Programme (SPREP)
PO Box 240 Apia, Samoa
sprep@sprep.org
www.sprep.org

Our vision: A resilient Pacific environment sustaining our livelihoods and natural heritage in harmony with our cultures.

Cover photo: Mr Posa Skelton

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The Pacific Islands Climate Services (PICS) Panel endorsed by the Pacific Meteorological Council in July 2013 and established in March 2014 is a technical expert group for Climate Services. Goals of the PICS Panel are to 'improve coordination, continuity, and integration of projects, programmes, and initiatives that support climate services at national, regional, and global levels among others.

This compendium was identified a key priority of the PICS Panel Action Plan highlighting the need to document progress made by each NMS through their experiences in implementing climate services at the national level. The compendium is also able to identify opportunities and best practices for contributing to resilient development in the region.

Special Acknowledgement: We would like to thank the WMO and Environment and Climate Change Canada for their contribution to the development of the compendium.

Special thanks to the team of mentors: Pauli Jokinen (FMI), CeciliaTamara Avellan (WMO), Salesa Nihmei, Sunny Seuseu, Tommy Moore (SPREP), Melissa Matthews and Molly Powers-Tora (BoM), and Tiffany Straza (Science Editor) who provided guidance to the authors from NMHS during the Writeshop.

Our vision: A resilient Pacific environment sustaining our livelihoods and natural heritage in harmony with our cultures.

The Secretariat of the Pacific Regional Environment Programme (SPREP) is the regional coordinating organisation for the protection and sustainable development of the Pacific island environment.

SPREP was established by its member governments in1992 to support cooperation and coordination across the region. The agreement establishing SPREP came into force in 1993, officially making the organisation an autonomous body.

With headquarters located in Apia, Samoa, SPREP works closely with its 26 Member countries and territories – along with partners, donors and local communities – to deliver on environmental management and sustainable development in the region in four priority areas:

- BIODIVERSITY AND ECOSYSTEM MANAGEMENT
- WASTE MANAGEMENT AND POLLUTION CONTROL
- CLIMATE CHANGE
- ENVIRONMENTAL MONITORING AND GOVERNANCE

KEY ACRONYMS

FINPAC	The Finnish-Pacific Project, coordinated by SPREP. www.sprep.org/finpac
SPREP	Secretariat of the Pacific Regional Environment Programme. www.sprep.org
WMO	World Meteorological Organization. www.wmo.int

Foreword

The livelihoods of Pacific communities are dependent on weather and climate conditions. In the large Pacific region, with diverse, far-spread communities with limited transport and communication services, providing targeted weather and climate information and forecasts is a complex task.

This compendium of case studies from Pacific island countries is a product of the Finnish-Pacific (FINPAC) project on 'Reduced vulnerability of Pacific islands country's villagers livelihoods to the effects of climate change', funded by the Ministry for Foreign Affairs of Finland (MFA) and executed by the Secretariat of the Pacific Regional Environment Programme (SPREP), the Finnish Meteorological Institute (FMI), and the Pacific National Meteorological and Hydrological Services (NMHS). This compendium showcases some of the Pacific contributions to the implementation of the Global Framework for Climate Services (GFCS) coordinated by the World Meteorological Organization (WMO).

Our objective for this compendium was to document the lessons learned from delivering climate services in the Pacific region. The experiences of National Meteorological Services in their work with different users and stakeholders provide vital information for future management and resourcing of climate and weather services.

These case studies were provided by Pacific authors and initiated during a regional writing workshop by FINPAC and SPREP in partnership with the World Meteorological Organization (WMO), Environment Canada, and the Australia Bureau of Meteorology through its Climate and Oceans Support Programme (COSPPac). The Pacific Islands Climate Services (PICS) Panel reviewed the compendium contents.

The vital services provided by Pacific Islands National Meteorological Services are supported by strong communication and mutual understanding of successful strategies.

We invite you to learn from the authors here and go on to share your own story.

Kosi Latu
Director General, SPREP

Matti Eerikäinen
FINPAC Project Coordinator,
Finnish Meteorological Institute

Dr. Petteri Taalas
Secretary General,
World Meteorological Organization

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Sunny Seuseu, SPREP

Empowering National Meteorological and Hydrological Services to share their stories

Author organisation	SPREP and WMO
Contact person's name	Netatua Pelesikoti
Contact person's email	netatuap@sprep.org
Providers of the service (including partners)	SPREP, WMO and COSPPac
Project timeframe	2012–2017
Location	Southwest Pacific
Primary target audience	Technical Staff of NMHS, Donor Partners
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Summary

In a large, diverse region like the Pacific, clear and concise communication of both successes and lessons learned is vital for further effective development. A workshop was created to help the participants develop stories to "tell the world what the Pacific is doing on climate services." The week-long writing workshop or "writeshop" created a space for climate service providers to learn outreach writing skills and how to analyse their own efforts. The writeshop was coordinated by the Secretariat of the Pacific Regional Environment Programme and the World Meteorological Organization (WMO) with support from the Climate and Oceans Support Programme in the Pacific (COSPPac) and Environment and Climate Change Canada. This first writeshop for climate services in the Pacific was a productive and intense week of growth for the participants, resulting in 20 stories for a regional compendium.

Background

The Global Framework for Climate Services (GFCS) was established in 2009 as an international initiative spearheaded by the WMO to advance the use of climate information in decision making for climate change adaptation. Adapting to climate variability and change can happen today using climate information and products ranging from seasonal forecasts to decadal predictions. National Meteorological and Hydrological Services (NMHS) around the world have been optimising the science behind their climate products for decades but can benefit from more interaction with the entities and individuals who can make use of these products in their daily decision making. Nonetheless, many examples exist where climate information has been turned into a climate service.

NMHS have implemented a range of projects at the national level with four regionally coordinated projects actively advancing climate information, products and services: the Australian Bureau of Meteorology's COSPPac, the Government of Finland's FINPAC; the Environment and Climate Change Canada-funded Programme for Implementing the GFCS at Regional and National Scales; and the National Oceanic and Atmospheric Administration's Pacific Climate Information System at national and regional scales. To better document these advances, the project partners decided to call for case studies on climate services in the region. Recognising that the technical staff of the meteorological services may be challenged due to time constraints and capacities to write these climate services stories, the organisers invited one member of each NMHS to a one-week writeshop, empowering climate service staff to share their stories.

The writeshop connected technical experts in scientific communication and meteorology with meteorological practitioners. "Emphasis [was] placed on looking for common approaches, good practices, across the Pacific that can be shared with other regions", according to the Fiji Meteorological Service Director, Mr Ravind Kumar.

Methods

Intensive work on the concept, template, and timeline for the writeshop took place among WMO, SPREP, SPC, BoM, and FMI in the early parts of 2015. A draft concept and template was presented to and reviewed by the Pacific Islands Climate Services Panel in May 2015, an advisory panel to the Pacific Meteorological Council. The documentation was finalised in July 2015 and a call for case studies launched in August. Invitations to National Meteorological and Hydrological Services (NMHS) went out in July 2015 through SPREP. The writeshop was held from 7 to 11 September 2015 in Nadi, Fiji. As a regional hub in the Pacific, siting the workshop in Fiji simplified the logistical challenges that can often hamper Pacific-wide events.

Fifteen staff of 14 Pacific Island NMHS took part and were guided by eight mentors from all partnering organisations. Mentors came from a mix of backgrounds, including meteorology, communications, social sciences, biology and oceanography, with diverse cultural backgrounds, while maintaining gender balance. A science editor was hired for the review of the overall compendium and also assisted with guiding and facilitating the workshop. Participants from NMHS were mostly climatologists, but a director and a deputy director also took part. Four female representatives of NMHS attended.

The agenda for the week was set as follows:

Day 1 Introduction to the purpose of the writeshop; defining the objectives, audience, and key messages. These key components needed to be defined as a group for the compendium, while at the same time introducing these as concepts to address when preparing to write.

Day 2 Introduction to the template and writing time. This loosely structured day was much appreciated, and there were no problems with people not using the time for writing. Drafts were submitted to the editor by 5 pm and were edited in the evening for discussion the next day.

Day 3 Writing time and one-on-one discussions with two to three mentors. Trust is an important part of writing and sharing information. Having one of the mentors be someone known and trusted was important. The mentor did not necessarily need to be an Islander, but that was the case during the workshop.

Day 4 Introduction to the basic principles of storytelling; writing time; one-on-one discussions with two to three mentors; peer review.

Day 5 Completion of the writing; closing analysis.

The workshop structure made it possible to gain early group agreement on the objectives and audience for the written products, and key decisions shaping subsequent work. Some of the participants were eager to simply learn the template and begin writing. However, once they began, they realised the challenges and the need for defined goals, and the subsequent mixture of activities and support was beneficial.

With the demand for three drafts throughout the week, the participants worked hard each day. Although participants were on individual laptops much of the time, the time was actually spent writing their chosen work.

Stakeholders

The stated target for the writeshop was the meteorological services staff, to build the capacity of climatologists to write stories that are technical or non-technical in nature and useful for a wide range of audiences. (In contrast, the resulting compendium is designed to serve the needs of the donors and regional audience.) Often, the demand for written products tailored to different audiences is not supported by writing training or time to develop such products. Technical staff accustomed to writing donor reports or internal reports often perform poorly when writing proposals, external communication products, or media releases. Some meteorological offices do not prioritise such communications.

Clear, timely communication improves the provision of services (by joining the service provider with their communities of users) and increases the success of programmes (by creating or strengthening relations

with donors and colleagues). The writing techniques provided in the writeshop equipped staff to write for a broad range of audiences, increasing their value as staff members and helping local offices gain greater support for their work.

The Pacific Island Climate Services (PICS) Panel provided overall guidance for the planning and execution of the writeshop. The writeshop was co-funded by SPREP and WMO through the FINPAC Project (funded by the Government of Finland) and the Environment and Climate Change Canada-funded Programme for Implementing the GFCS. Technical support was provided by the Australian Bureau of Meteorology through the COSPPac Project.

Management

Prior to the writeshop, the meeting arrangements and calls for case studies were led by SPREP through the Pacific Meteorological Desk Partnership team with support from WMO and COSPPac. The planning of the writeshop took almost three months with five planning teleconferences, increasing in frequency during the last two weeks prior to the workshop date.

The skills needed to engage participants and produce stories included familiarity with the local context and the professional context, technical training, technical writing/journalism training, and experience teaching or designing news story structure. The team of facilitators was chosen to combine all of these roles and skills.

The meeting was the first of its kind for most of the facilitators, and the editor was brought in at the beginning of the writeshop after the agenda had been set. The team of eight facilitators used a flexible approach, meeting at the end of each workshop day to debrief, plan, and alter the following day's schedule as needed.

> "Thank you for the opportunity to peer review someone else's work."

Resources

Prior need:

The climate services staff stated the following needs at the beginning of the writeshop and used the writeshop to address these limitations:

- Time in 'at home' offices to write is limited or does not exist yet. Staff need time to learn how to write, and time to actually write;
- Staff need writing skills, in terms of both focusing techniques and building capacity for writing techniques;
- Staff need story skills: to know what to write, for whom;
- Staff often lack confidence in their writing or their English;
- Staff often lack an audience for their writing:
  - need to showcase Pacific activities on climate services; and
  - need time or avenues to share their learning; and
- National Met Service staff need relationships with mentors or immediate access to mentors.

Participants discuss audience for the Compendium. Photo: Christina Leala-Gale, SPREP

Needs at the writeshop

The ideal writeshop location as identified by the participants and organisers was a comfortable, bright environment with work tables, additional rooms or places outside for one-on-one sessions, booked as a retreat with everyone together (with food on site to avoid lost time). For example, the local met office closes at 5 pm, whereas in the chosen location, writeshop participants were regularly writing until 6:30 pm and later. These simple considerations had a disproportionate effect on the function of the writeshop and should be incorporated when planning similar events.

The resources required to arrange and host the workshop included funding for the facilitators, including a contracted teaching editor, travel and accommodation costs for the participants and the normal logistical expenditure for venue, catering and communication.

The high ratio of facilitators to participants was important. For the first discussion groups, starting with story-boarding each participant's case study, each facilitator participated in at least one session with the teaching editor for the facilitators to learn how to engage with participants to draw out stories. Consistency in messages to participants was vital and was produced by this working familiarity and daily check-ins. After that initial hands-on training, concurrent discussion groups using different facilitators was effective.

Outcomes

> "This was the best way to collect stories; previously, it was a challenge to actually get good stories from any met service."

The writeshop was reported as a success by nearly every participant and facilitator. Participants focused intensively on writing and stayed after hours to continue working on their stories. Each participant left with a solid draft of at least one case study.

Outcomes of workshop

- Participants left with content and a basic storyline;
  - Participants stated more confidence in writing, greater likelihood of writing in the future; and
  - Managers and other staff who had been contacted by the participants during the week placed writing in higher regard.
- A compendium could be created with the writeshop products as the starting point, following further drafting, review, design and publication;

Outcomes for participants

- Participants showed interest in sharing their skills at their home office and conducting similar sessions regionally/locally;
- This writeshop process was identified as a useful way to collect products.

Group discussions with the help of mentors was effective. Photo: Christina Leala-Gale, SPREP

Lessons Learnt

Matching facilitators with participants required sensitivity, particularly for small-group discussions. We observed success when a more technical person was there along with a communications person and, when possible, one local or otherwise 'familiar' person (in this case, each group needed a Pacific islander). The presence in each small group of a person with familiarity with the service or region was helpful.

Follow-up proved to be more difficult when participants and facilitators returned to their busy schedules with large geographic separations. Most participants had little or no time to focus on finishing their stories because they have a very demanding workload in the office. Establishing mentoring partnerships, i.e. assigning certain stories to specific people, was necessary.

Key Writeshop Challenges

- There was some frustration or fear related to English as a second language, but this challenge was not wholly limiting or damaging and should not serve as a barrier to writeshop participation.
- Participants were only familiar with a specific style of writing (grants or formal project reports) or had no prior training in writing.
- In the early stages, participants struggled to focus on one story. Alleviating this problem requires a low-pressure environment where participants do not feel they must show everything that they or their country does, participants know that facilitators are not 'judging' the story, and participants have confidence that their product is their own.
- There was some frustration due to time pressure within the five day timeline. Some participants locked in to a negative mindset because they felt they did not 'have anything' or were not getting enough support from their home office.
- Specific instructions from the home office were sometimes provided, pressuring people to write a certain thing even if that content was not enough or not appropriate. Engaging participant's managers early to allow flexibility during the writeshop would allow for creation of stronger stories and greater skill development of the participants.
- A minor issue of participants not being prepared with the right kind of information was encountered, but writing skills or story creation could be developed even with limited details.

Key Writeshop Successes

- An anonymous space to ask queries, suggest tips, etc.: a notice board was appreciated and well used;
- Story telling: having a 'local' tell their story out loud, with another facilitator pausing them and pointing out the parts of a story's structure;
- Presentation of a writing template: when the template was presented on the second day, people felt like they were finally getting "the real stuff";
- Letting the participants write and get stuck, then providing more theory and support, was an effective strategy. Some participants did not appreciate theoretical or structural discussions until they had started to write and discovered their own need. It was important to spend time writing throughout, rather than spending the week on theory and only allowing writing time on the last day;
- Mentors: using communicators in addition to technical staff as mentors was key;

- Respecting stories: facilitators committed to prompting instead of re-writing immediately, helping people unravel their own stories. This approach is much better for participants to build their own skills;
- Flexible approach: adjusting the agenda reflexively, day by day, worked well and allowed responsiveness to the participant's needs and the experience level of the facilitators.

Lessons learned

- The facilitator's decision to start each day with an activity was beneficial, and such activities should be built into the schedule for any subsequent workshop.
- Involvement of the editor in the writeshop scheduling was helpful, and earlier and/or greater involvement with the template and writeshop design was suggested as beneficial by the editor and other facilitators.
- The communicators facilitating the workshop had technical expertise, teaching experience, and communications training. This mixture was ideal.
- The concept of story structure was useful and should be presented early in the week.
- Have people tell their stories out loud, informally (so the group hears other's stories, in addition to having people tell their story more often), perhaps starting on the first day. In this writeshop, pairs of participants discussed and then introduced each other's stories. This was good, but it would also be helpful for each participant to tell their own story to the group.
- Pre-mentoring to narrow topics (and collect supporting materials) would be useful if the goal is to gain a final version at the end of the 5 days.
  - To do this requires permissions and organisation from the entities involved; and
  - Success in this collation would require starting the whole process earlier.
- Peer review was identified as helpful. People were assigned in pairs because the participants were requested to discuss the material as well, and it was easier/more time efficient to have discussion pairs already together. If the feedback was only written, having random assignments among the group would work.

Future

The writeshop was a productive environment for communication specialists to interact with climatologists and learn from each other. The authors took their stories home and submitted their next drafts for a compendium. These drafts were edited, reviewed, and revised for final publication over several months. Successful follow-up depended on continued relationships and long-term focus on the project.

The success of the writeshop format will inform future production of written case studies. The lessons gained within the writeshop are helping individual participants write more confidently and successfully within their tasks.

The writeshop was a success in building the capacity of climatologists to write stories that are non-technical in nature and are useful for a wide range of people/expertise.

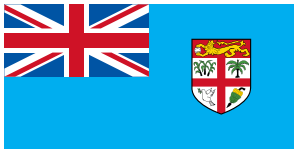
> "I never knew that I could write!"

SECTION 1

Agriculture and Biodiversity

Salesa Nihmei, SPREP

Using seasonal rainfall predictions to support subsistence farmers in disaster risk reduction



Author organisation	Gavin Kenny (FAO/Consultant) and Olivia Warrick (Red Cross/Red Crescent Climate Centre)
Contact person's name	Gavin Kenny and Olivia Warrick
Contact person's email	gavinkenny@clear.net. nz
Providers of the service (including partners)	Fiji Meteorological Service; Fiji Ministry of Agriculture; Food and Agriculture Organisation of the United Nations; European Commission; University of the South Pacific; Foundation for Rural Integrated Enterprise and Development (FRIEND); Live and Learn; Adventist Development and Relief Agency (ADRA)
Project timeframe	June 2015–Dec 2016
Location	Fiji
Primary target audience	Farmers
Funding mechanism(s)	European Commission's Disaster Preparedness ECHO (DIPECHO) programme

Summary

The Australian Bureau of Meteorology (BoM) and the International Federation of Red Cross and Red Crescent Societies (IFRC) have produced a simple Seasonal Rainfall Watch tool to encourage Pacific Red Cross societies to use seasonal rainfall information in preparedness planning.

Recently, the Fiji Meteorological Service (FMS) recommended that the Seasonal Rainfall Watch be used as a basis for the development of agro-meteorological services to subsistence farmers in Fiji. This case study offers insights from the first stage of this initiative.

Background

In late 2014, the Food and Agriculture Organisation of the United Nations (FAO) developed a proposal for the European Commission's Disaster Preparedness ECHO (DIPECHO) programme[1] to strengthen rural subsistence farmers' capacity with skills to reduce disaster risks. This funded project is focused on 'Enhanced national and local capacities for integrating disaster risk reduction in agriculture in national services and community practices in high-risk Pacific Island Countries'. The DIPECHO project has an accompanying FAO Technical Cooperation Program and is supporting activities in Fiji, Vanuatu, and Tonga.

An important component of both the DIPECHO project and accompanying Technical Cooperation Program is to support the development of agro-meteorological services in the participating countries. Key components, from the original project proposals (in Fiji and Tonga), are capacity building of Ministry of Agriculture staff and development and dissemination of user-friendly agro-meteorological bulletins to farmers.

The focus in Fiji and Tonga on capacity building and agro-meteorological bulletins is aligned with some of the key needs identified from an Expert Roundtable on climate services hosted by FAO in February 2015. There is already a range of meteorological products available to Pacific island countries, so making better use of existing products and data to support subsistence farmers' decision-making is a priority.

1 http://ec.europa.eu/echo/what/humanitarian-aid/risk-reduction_en

One such existing product is the Seasonal Rainfall Watch. This tool is being adapted to the Fiji agricultural sector as a basis for development of agro-meteorological services for subsistence farmers, with support from the DIPECHO project outlined above. Each month, the BoM and the Pacific National Red Cross Societies issue a simple bulletin that points to a colour-coded alert level depending on the probability and confidence of above or below average rainfall for the coming three months in a number of Pacific Island countries. Information for the bulletin comes from Pacific Island National Meteorological Services' monthly seasonal forecasts.

Every month, countries are grouped into a summary table, depending on their alert level.

Alert Level

◀ Increasing chance of drier 3 months — Increasing chance of wetter 3 months ▶

Alert Level	Divisions with Below Normal Rainfall favoured in the coming 3 months	Alert Level	Divisions with Above Normal Rainfall favoured in the coming 3 months
	Samoa		Solomon Is. (Western Region)
	Cook Islands (Southern) Vanuatu (Southern)		Cook Islands (Northern), Solomon Is. (Central and Eastern Regions)
			Tuvalu

Example of the alert information that the Red Cross and National Meteorological Services received from the Australian Bureau of Meteorology, which is in turn inserted into a table that has pre-determined preparedness measures.

This alert system is then linked to general preparedness measures tailored to Red Cross National Societies, based on the level of alert.

ACTION Level	Divisions/ Regions	Recommended actions (predetermined by IFRC office)
LOW ACTION	Samoa	** Ensure normal preparedness activities are done, and also: – Use IFRC low rainfall/drought check list for preparedness activities or use your own adapted one – Check that you have sufficient emergency response stocks; for example, do you have enough water storage containers like jerry cans and buckets, and are these are available to all areas that you are committed to serve – Check that your reverse osmosis/ desalination plants are functional, that you have spare parts (refer to comment in footnote)[2] and that there are enough qualified staff/volunteers to operate – Regularly monitor climate and weather updates from Met Service

Example of Pacific Red Cross preparedness measures linked to a 'low' level of alert for a forecast of below average rainfall.

Methods

Within the above context, a participatory planning process was completed in Fiji in June 2015. Key steps to this process included the following:

- the Acting Manager for Climate Services of the FMS and key Fiji Ministry of Agriculture (MoA) extension, livestock, and communications staff met to present all relevant seasonal outlook products and services currently available to, and provided by, the FMS; and
- products and services identified in the above step were reviewed to identify how they might be refined or developed further to provide relevant information to farmers.

The general agreement was that the seasonal rainfall predictions as presented in the Red Cross Seasonal Rainfall Watch provided a simple and effective means of communicating complex scientific information to farmers. Subsequent participatory planning focused on how the colour-coded seasonal rainfall predictions in the Seasonal Rainfall Watch could be used to shape relevant advice to farmers.

A workshop was facilitated in September 2015 with Fiji MoA extension and livestock staff to capture their knowledge in relation to the likely responses to different rainfall prediction categories (in the Seasonal Rainfall Watch) on different crops and livestock.

- The workshop exercise will be repeated with extension staff in all divisions/island groups in Fiji to gather more localised data and verify national-level data.
- In parallel, the DIPECHO project is working with the University of the South Pacific (USP) in Suva to identify traditional farmer coping mechanisms with the help of communities, NGOs, and government representatives.
- The above planning process serves as both a learning-by-doing capacity building exercise for MoA staff and community and as a means of capturing their collective knowledge.

Stakeholders

Within the DIPECHO project, key government stakeholders in Fiji are MoA and the FMS. Other stakeholders in Fiji include USP and the NGOs FRIEND (Foundation for Rural Integrated Enterprise and Development), Live and Learn, and ADRA (Adventist and Development Relief Agency).

All of the above-mentioned stakeholders were involved in the original project proposal development and the agro-met work plan development.

Key stakeholders related to the Red Cross Seasonal Rainfall Watch are the Australia BoM, IFRC Pacific Regional Office, Red Cross/Red Crescent Climate Centre, Pacific Red Cross National Societies, and Pacific National Meteorological Services.

Resources

The main resources required for this work are human resources, including:

1. people with relevant agro-meteorological experience to facilitate workshops;
2. sufficient MoA staff, and community members, participating in workshops as well as willingness on the part of NGOs to train in community facilitation and on the part of communities to volunteer their time to share their knowledge. An absolute minimum of 16 participants is required for the workshop process to be effective; and
3. availability of meteorological service staff to contribute to workshops (this is a potential constraint).

The above will be reviewed as the work progresses.

Outcomes

The results of the initial participatory extension officer workshop exceeded expectations. The workshop process was initiated with all groups focused on root crops, identifying actions relating to the key stages of planting, growing, and harvesting (in the case of livestock, these 'stages' were separated into commodity and husbandry; for tree crops, the 'stages' were tree species selection, growing, harvesting, and uses). Results from all groups were discussed sequentially, and a consensus table was completed as a result. To complete the table, participants rotated among fixed topic groups and added to or modified information provided by preceding groups.

Table 1 shows the outline table that was populated with outputs from the workshop as in the example provided in Table 2. Note that the Community Indicator column would be kept blank to enable communities to record their local indicators in relation to the different rainfall prediction categories. This information might be referred to as 'traditional knowledge' but also provides scope for new indicators that relate to changing conditions (e.g. as a result of climate change).

Table 1: Seasonal rainfall predictions (becoming drier, wetter, or neutral), community indicators, and responses

Seasonal rainfall prediction	Community indicators	Root crops	Vegetable crops	Grain crops	Fruit crops	Tree crops (including handicraft)	Livestock
Very dry							
Moderately dry							
Dry							
Neutral							
Wet							
Moderately wet							
Very wet							

Table 2: Example of responses identified for root crops in relation to a 'very dry' seasonal rainfall prediction

Seasonal rainfall prediction	Root crops
Very dry	**Planting**: sugar cane, early cassava, yams, dalo (swampy areas), kumala (variety, irrigation and shade), shade trees **Growing**: irrigate, *mulching (cut or leave grass), trellising (site selection), store water **Harvesting**: early harvest, normal, *post-harvest preservation, plant material preservation

Seasonal rainfall prediction goes a long way in helping farming communities.
Photo:IFAD project development team

Once finalised, the table could be printed and made available for communities. The completed table would also provide baseline information for MoA staff to develop agro-met bulletins based on regular updates received from their respective meteorological services.

Lessons Learnt

At this very early stage of the project, the Red Cross Seasonal Rainfall Watch provided a simple framework to draw out the knowledge and experience of agricultural extension officers in relation to seasonal rainfall forecasts. This approach provided space for cropping and livestock specialists to share their knowledge and its application in practice. It helped them learn different perspectives from one another, in contrast to the previous situation when these specialists typically worked independently, and created a hunger to learn more about meteorology and its impact on the agricultural sector. Sharing knowledge built confidence in and ownership of that knowledge and provided something tangible regarding what was being done 'right now' in terms of El Niño, for example.

The advice coming out of this initial workshop will be further refined over 2016, when the tool will be tested in rural communities.

These lessons are aligned with key lessons that are emerging from the Red Cross's application of the Seasonal Rainfall Watch tool in disaster preparedness programming.

Future

The initial workshop process will be repeated in Tonga, using a rainfall prediction tool recommended by the Tonga National Meteorological Service, and extended to involve as many extension and livestock staff in both Fiji and Tonga as possible. The DIPECHO project is the first application of the Red Cross Seasonal Rainfall Watch in a specific country and sector context. Further customisation of the tool to different country contexts so that alert levels are tailored to national and locally relevant actions is a priority moving forward.

One of the follow-up Agromet workshops in Tonga, February 2016. Photo: Gavin Kenny

The Protected Areas Network (PAN)

Author organisation	Republic of Palau
Contact person's name	Kikuko Mochimaru – Palau National Weather Service Office, Protected Areas Network Fund
Contact person's email	info@palaupanfund.org
Website	www.palaupanfund.org
Providers of the service (including partners)	National Weather Service of Palau, Palau Protected Areas Network Fund, National Emergency Management Office, national Emergency Committee, Presidents Office, national, local, international partners.
Project timeframe	2003–present (Launch March 2012)
Location	Initial 4 states (2010): Melekeok, Hatohobei, Ngarchelong, and Ngiwal state governments/ communities. An additional 9 states joined in 2012, and to date, 15 of 16 states of the Republic of Palau are members
Primary target audience	16 states and communities of the Republic of Palau
Funding mechanism(s)	Protected Area Networks Fund

Summary

The Republic of Palau created a network of protected areas of marine and terrestrial resources designed for the 16 states of the Republic of Palau largely as a result of the 1997 El Niño, a thermal stress event that triggered coral bleaching in 1998, affecting 90% of Palau's coral reefs with mortality over 50%. Palau's National Weather Service provides weather and climate products to inform communities and the Palau Protected Areas Network (PAN) site owners (private and public) and managers.

Background

The Republic of Palau (ROP) has 70 marine lakes, endemic marine habitats in great variety and quantity, and the highest number of native marine and terrestrial species per unit area in the world (www.palaupanfund.org/history.html). The forests preserve drinking water, decrease the velocity of water flow to the sea, and protect the reefs by filtering sediments that smother reefs. Fish and other marine animals provide the majority of the protein consumed annually. A variety of food products, traditional herbs and medicines, building materials, and décor for attire and customary functions are derived from plants and other species found in Palau's ecosystems.

However, extinction of species, coral bleaching, drought, wildfires, and diseases and other impacts were attributed to climate hazards, such as drought due to El Niño conditions and torrential rainfall, run-off, storm surge, inundation, coastal erosion and damaging winds due to La Niña, tropical cyclones and other natural disasters. Additionally, illegal fishing, poaching, unsustainable development of land, and introduction of invasive species increase the threat to Palau's precious resources. These impacts are detrimental to food security, life, property, economic stability, and health.

The Protected Areas Network (PAN), a nationwide strategy, was created to address those concerns and to meet the goals of the Micronesian Challenge, a regional commitment by the ROP, Federated States of Micronesia, Republic of the Marshall Islands, Territory of Guam, and the Commonwealth of the Northern Marianas to support environmental conservation, protection of biodiversity, sustainable development, and climate change preparedness. The Micronesian Challenge is to effectively conserve 30% of near-shore marine and 20% of terrestrial resources by 2020. The states of ROP and members of the communities are the resource owners of the PAN sites, and the communities (the local people, non-residents, and tourists) in these states are the resource users.

Methods

Palau, one of the world's largest marine sanctuaries. Photo: Matt Rand/AFP/Ghetty Images/The Guardian

In response to the visible impact on corals from El Niño thermal stress, the PAN Act, Green Fee, and PAN Fund were established, created, and enacted. The PAN Act is a system of support from the National Government of Palau to the States for their conservation programs. The Green Fee is an environmental impact fee, of $15 per non-Palauan passport holder, that was developed to fund protected areas and is generated from two points of entry: the ocean and the airport. The Protected Areas Network Fund (PANF) is a registered non-profit corporation that serves as a financial trustee of the assets obtained to support PAN and to manage funds from donations and arrival fees (Green Fees). PANF recorded Republic of Palau Green Fee transfers totalling $4,594,128 and Green Fee receivables totalling $4,313,762 from 2 November 2010 to 30 September 2012.

The National Weather Service (NWS) in Koror, Palau, the local climate services, provided meteorological information including precipitation and wind parameters for studies on watersheds and the effect of run-off on corals as a product of human-induced land-use change and natural changes to the land, considering the effects of extreme rainfall events from various climate features. NWS's Meteorologist in Charge, Maria Ngemaes, has partnerships in a number of committees that provide managerial support for management of PAN sites, political support to the Republic of Palau in nationwide decision making and disaster risk management, community support through public awareness, and educational support to all sectors on weather and climate information.

During severe weather/climate phenomena, information and regular updates of the event take priority. In the event of a threat from a natural phenomenon, radio and television personnel would meet and work closely with the local NWS, the National Emergency Management Office, the National Emergency Committee, and a representative(s) of the President's cabinet to reduce damage to life and property by setting up an incident command system involving first responders, delegating evacuation centres, assisting in evacuations, and securing life and property, while keeping the public informed as the situation intensifies and/or deteriorates.

Stakeholders

With the support of the National Government of Palau, PAN management plans were developed by the states. Comprehensive cost analysis and sustainable financial management plans, varying in lifespans of 4–5 years, were produced with advice from traditional leaders, community-based organisations (men and women groups), and technical support from organisations/agencies such as Palau International Coral Reef Center, the Belau National Museum, Environmental Quality Protection Board, Palau Conservation Society, and the Bureau of Marine Resources to preserve, conserve, and manage natural marine and terrestrial resources. States nominate areas within their boundaries that are environmentally or ecologically significant. Upon approval of nomination, the site gains membership into the PAN network and funding for managements of PAN sites.

Management

The PAN Fund is mandated to seek outside funding for the state's conservation and sustainable development efforts, control funding via an endowment fund—the Micronesian Conservation Trust, and ensure that funds are used for the purposes established and required by donors. The Green Fee was developed to fund protected natural resources, although some States may already have visitor user fees in place, and as a result, collection and disbursement of fees allowed States to start capacity building in implementation and reporting.

Resources

Even with the foundation in place, other means of funding are still needed when there are fluctuations in the number of annual visitors to Palau. Capacity building is also important, with staff needs including reporting, enforcement and monitoring of PAN sites, and education on climate change. Also, as stated by King Sam, PAN Project Manager, "Coral research on resilience to increased sea surface temperatures, ocean acidification, and other information will help PANF managers to indicate biodiversity hot spots in Palau and work with States to establish some level of protection and regulations in those sites to ensure that it remains intact."

Outcomes

The small island nation tackled a great undertaking. At the launch of PAN in 2010, four initial states were involved, with nine more joining in 2012. By 2015, 15 of 16 ROP states had PAN sites, totaling 20 marine and 12 terrestrial PAN sites. There is twice as much fish biomass in PAN sites compared to adjacent non-protected areas. Top predators or large fish usually caught by fishermen/women are five-fold more abundant than in non-protected, controlled sites (Friedlander et al. 2014). There has also been an increase in bird species in the terrestrial sites of the PAN.

Lessons Learnt

ROP's culture and history are based on principles of conservation, which were the basis for the development of the PAN. Integration of local and traditional knowledge is an important part of the process, with involvement of resource owners and users shaping the goals for PAN and ensuring it is working with stakeholders, incorporating their needs in ownership and implementation of management plans. Political and community support is essential for the success of the PAN.

Seasonal forecasts by regional climate services are used to identify strong El Niño events. National activities to respond to the 2014/2015 El Niño still in use include:

- PEAC audio conference (monthly);
- NWS: Drought Information Statement for Palau;
- NOAA/NESDIS/National Climatic Data Center: USA Drought Monitor;
- USA-affiliated Pacific Island Stations receive weekly US Drought Monitor Assessments (Experimental) and Rainfall Analysis Spreadsheets;
- President's Press Conference (radio and television); and
- leadership meetings with legislative branches.

Challenges

The continuing needs of providing outreach to all sectors on weather and climate and producing seasonal products at a local level have been addressed through training and guidance at regional and global levels. Maintaining long-term sustainable networks requires support from the states and communities. Funding for PAN and climate services has been provided by donors and sponsors, both regional and global.

Future

The Republic of Palau's Protected Areas Network continues to operate successfully with support for:

- Republic of Palau National Government legislation via the Marine Sanctuary Act (RPPL 9-49) and Marine Protection Act (RPPL 9-50) signed October 2015;
- States of Palau management plans, and active management and protection of conservation sites;
- education and outreach, particularly regarding climate change;
- community support of conservation and sustainability;
- achieving the goals of the Micronesian Challenge: 30/20 by 2020;
- the PAN sites, with the goal of inclusion of all 16 states of the ROP with PAN site(s); and
- the PAN Fund, which continues to seek investments and funding for PAN efforts.

With collaboration and support from global and regional climate services, the local climate services (NWS) aims to extend and improve outreach coverage and methods, respectively, with PAN management and within the communities to assist the ROP with adaption, mitigation, and sustainability efforts in a changing climate.

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Abundant marine life in the Palau Protected Areas. Photo: Ethan Daniels

Climate forecasts for honeybee husbandry

Author organisation	SPC/GIZ
Contact person's name	Christopher Bartlett
Contact person's email	Christopher.Bartlett@giz.de
Providers of the service (including partners)	Vanuatu Meteorology & Geo-hazard Department
Project timeframe	2009–2018
Location	Pele Island, Republic of Vanuatu
Primary target audience	Community honeybee farmers
Funding mechanism(s)	German Ministry of Economic Cooperation

Summary

Vanuatu's community honey bee farmers have benefited from climate forecasting advice, which is used to decide when to feed their bees considering the possible impacts of heavy rainfall on pollen availability. If above-normal rainfall is forecast for the coming months, then rural bee keepers will need to make arrangements to produce or purchase sugary substitutes for flower nectar.

Background

Vanuatu honey bee farmers are closely attuned to climatic conditions because rainfall patterns have a strong effect on the availability of pollen. When above-normal rainfall conditions persist, bees cannot find sufficient pollen in their foraging trips and are unable to produce sufficient honey to either develop the hive or provide excess for human honey harvest.

Honey bee farmers can and should manually feed their bees in times of excess rainfall, but in rural areas of Vanuatu, it is often difficult to produce local sugary bee-feeding solutions at late notice, and therefore, some advance preparation is required. If no feeding is done, the bee colony will suffer, and the farmer will likely forgo any honey harvest, leading to reduced revenue and other related impacts on local livelihoods benefitting from the trickle-on effect of this income.

Knowing well in advance if above-normal rainfall is expected greatly benefits local bee farmers, giving them time to prepare for bee-feeding activities.

Bee keeping expert David Gibson providing training to students during school visit. Photo: GIZ Vanuatu Office

Methods

The Coping with Climate Change in the Pacific Islands Region (CCCPIR) project from the Pacific Community (SPC) and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) has been working with the Government of Vanuatu and its rural

communities since 2009 to trial and implement locally appropriate measures for adaptation to climate change. To address community food security needs and to boost agricultural productivity, the programme supported an expansion of honey bee keeping into its ongoing activities because bees are a key pollinator of many locally grown vegetables and a source of income for rural farmers.

It was soon realised that advance warning of above-normal rainfall would benefit local bee farmers, giving them time to prepare for necessary feeding activities. To source this information, the SPC/GIZ programme collaborated closely with the Vanuatu Meteorology & Geohazards Department (VMGD), which releases regular climate outlooks and provides exactly the type of above- or below-normal rainfall forecast information required. When an above-normal rainfall outlook was released, the SPC/GIZ programme tailored this message through one-on-one engagement with its key farmers into a clear directive for bee farmers to begin producing sugary solutions for bee feeding.

Stakeholders

The SPC/GIZ CCCPIR programme has been critical in providing a "bridging service" that is able to translate the technical climate outlook into a message and advice that is targeted at rural bee farmers who would ordinarily not have access to this information. SPC/GIZ has been working on the ground with rural communities in Vanuatu since 2009 and has developed close relationships with village leaders and key farmers, used for the transmission of contextualised climate adaptation and disaster risk information.

Vegetable and livestock farmers explain to GIZ and its government partners their informational needs, and GIZ facilitates the gathering and locally appropriate synthesis and passage of this technical information back to the grassroots level. The Government of Vanuatu, specifically through the departments of Meteorology and Agriculture, has found the technical and community perspectives brought by GIZ and its partners useful in their own message-delivery programmes.

Management

The German Federal Ministry for Economic Cooperation and Development (BMZ) is financing the SPC/GIZ Coping with Climate Change in the Pacific Islands Region Programme, which is jointly implemented by SPC, GIZ, and the Government of Vanuatu. Individual bee farmers on Pele Island make their own feeding and implementation decisions and only seek advice from GIZ and VMGD in regard to the most critical expected times of above-normal rainfall. Before engagement with the SPC/GIZ, local bee farmers had no idea that long-term rainfall seasonal forecasts were available, but CCCPIR helped them to connect with government services and use climate information for the benefit of their livelihoods.

Resources

The interest of local honey bee farmers in improving the husbandry of their animals is a prerequisite for the use of climate services. Farmers who actively manage their bees find seasonal forecasts extremely useful. Charley Manua, a bee farmer on Pele Island, boasts that "climate forecasts help me get my bees through those rainy hungry times; with the early warning, I can always expect the best honey flow on the island from my hives."

Local honey bee farmer checks his hive for capped honey (white) on the frame, and decides whether bees require further feeding due to excess rainfall. Photo: GIZ Vanuatu Office

Some human resources are required because an intermediary to translate the often complex language of seasonal forecasts into straightforward, bee-related advice (like “commence preparation of bee foods”) is needed, and with the work of the SPC/GIZ programme, this capacity has now been built within the government. The message and advice has been transmitted via radio, mobile phone technology, and in-person informational sessions.

Outcomes

Today’s rural honey bee farmers are vastly more resilient to the impacts of weather variability, including shifts in rainfall pattern due to climate change. Above-normal rainfall during peak flowering periods causes a loss of pollen for the bees. The ability of bee farmers to prepare in advance for bee feeding has meant that they can continue to earn income and expand livelihood opportunities even with climate disruptions. All of these outcomes have been accomplished with a small investment in communication and message dissemination to a specific rural farmer audience.

Lessons Learnt

- Bee farmers are negatively impacted by above-normal rainfall periods, which wash away pollen and cause food shortages for bee farms.
- Advance warning will enable rural bee farmers to produce timely food substitutes for their bees.
- Bee farmers would not ordinarily make a connection between a generic climate outlook and their own livelihood activity unless their awareness is strengthened.
- With the support of the VMGD and SPC/GIZ programme, VMGD climate outlooks were tailored into straightforward, bee-keeping-relevant advice.

Future

Once the bee farmers understood that above-normal rainfall forecast equated with low bee food availability, and that these forecasts could be obtained easily via the media or by calling the VMGD directly, the need for SPC/GIZ catalytic inputs was reduced. On Pele Island, bee farmers call the VMGD monthly for the latest three-month rainfall outlook. As soon as an above-normal prediction is announced, they immediately commence the production of sugary substitutes so they and their bees are well prepared.

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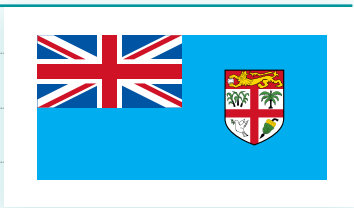
SECTION 2

Communication of Climate Information to the Last Mile

Nicollette Goulding, IFRC

Climate Information is essential to the energy sector



Author organisation	Fiji Meteorological Service (FMS)
Contact person's name	Arieta Daphne Baleisolomone
Contact person's email	Arieta.Daphne@met.gov.fj
Providers of the service (including partners)	Fiji Meteorological Service (FMS); Fiji Electricity Authority (FEA)
Project timeframe	2005–present
Location	Fiji
Primary target audience	Stakeholder: Fiji Electricity Authority (FEA)
Funding mechanism(s)	Core funding from FMS

Summary

Fiji uses hydroelectric energy to supply much of the nation's electricity demands, but this renewable energy relies on rainfall. The creation of a Seasonal Rainfall Outlook for Fiji Electricity Authority (FEA) was a joint collaboration between the Fiji Meteorological Service (FMS) and FEA, to assist in FEA's management plan for the dams. The bulletin contains brief descriptions of the past month, three months, and six months of rainfall for Monasavu, the current El Niño Southern Oscillation conditions, and predictions for Monasavu rainfall for the next three to six months.

Background

FEA, a statutory organisation, was established, incorporated, and constituted under the provisions of the Electricity Act of 1966 and began operating from 1 August of the same year (2014 FEA Annual Report). FEA was established with the responsibility of providing electricity to several parts of Fiji. In terms of renewable energy for FEA, the Monasavu Hydroelectric Scheme produces 80 MW, Nadarivatu Hydroelectric Scheme produces 40 MW, Wainikasou Hydroelectric Scheme produces 6 MW, Nagado Hydroelectric Scheme produces 1.40 MW, and Butoni Wind farm produces 10 MW on Viti Levu, and the Wainique Hydroelectric Scheme in Vanua Levu produces 0.8 MW.

The Monasavu Hydro Scheme, located in the interior of the Naitasiri Province, is currently the largest and tallest dam in Fiji and contains the largest reservoir in the country. The generation of electricity through hydropower is in line with the Department of Energy's move toward renewable energy. Hydropower relies on sufficient rainfall and appropriate water use to maintain power generation.

The most striking drought crisis since the dam was built was during the dry conditions following the 2002/2003 El Niño event, when the dam level readings dropped below the minimum level.

According to Mr. Rajendra Prasad, who was the director for Fiji Met during 1992 to 2010, FEA usually approached FMS for consultation whenever they felt a 'crisis looming', such as a tropical cyclone or dry conditions. An enhanced relationship between the FMS and FEA would enable FMS to provide guidance to FEA on the seasonal rainfall outlook for the next three months at Monasavu, helping FEA to plan whether to continue using hydropower or to use generators to provide power for Fiji. For instance, during much of 2014, Fiji started to experience drier than normal conditions. The Chairman's report from FEA's 2014 Annual Report noted that, "the El Niño weather pattern, causing prolonged spell of dry weather in 2014, forced FEA to implement its contingency plan by purchasing, installing and commissioning additional 40 MW of diesel generators."

Monasavu Dam. Photo: Adil Ali, Fiji Meteorological Service

Methods

FEA had been approaching FMS on an ad hoc basis for weather information, through the FMS director. Even before the tailor-made Monasavu Bulletin started, FEA often called in or visited FMS, with the intention of getting more information on 'looming crises', such as tropical cyclones or approaching dry spells. FEA often visited the office, or FMS management would be hosted at FEA National Control Centre, and there would also be presentations, especially on the current conditions and what was to be expected in the next week or three months.

Prasad mentioned that as time went on, the understanding of the different weather patterns that tend to affect the mountains of Monasavu improved for both parties, especially managers of FEA. Therefore, when FMS issued a forecast, the management of FEA understood what the expected weather pattern would be like in the next coming days or months. Various technical terms used during presentations were also increasingly understood by FEA management. As the tools of monitoring developed, FMS then ventured into providing seasonal forecasts for FEA.

Before the tailor-made FEA Rainfall Outlook, the Climate Service Division was already providing monthly bulletins, one of which was on the seasonal outlook for the next three months, previously made possible through the Seasonal Climate Outlook for Pacific Island Countries (SCOPIC) tool. SCOPIC is a decision-support tool used to generate seasonal outlooks for rainfall and temperature and other climate-related factors. It was designed to help the different Pacific Island countries make their own seasonal predictions because it only requires the different meteorological services to use their own climate data.

FMS to date is still providing the Fiji Electricity Authority with the Monasavu Seasonal Rainfall Outlook. The outlook continues to be used by FEA to provide guidance on what the rainfall is likely to be like in

the subsequent three months. Although there have been some changes in the format of the seasonal outlook, the amount of information provided has definitely increased. Since there have been monthly engagements of both organisations, some of the management of FEA are now mostly up to par on the knowledge regarding the different technical terms. The product started off with the incorporation of the rainfall outlook only. However, as time passed and as the SCOPIC tool developed, FMS also started to provide maximum and minimum temperature outlooks.

The technical officers based at Monasavu take daily observation readings and email the results to the FMS office, also including the daily dam level readings. Monasavu staff saw the importance of the provision of quality daily observation readings, which further encouraged them to continuously carry out daily observations. Weather information had previously been provided to FEA on an ad hoc basis and the collaboration between FEA and FMS has led to a much clearer understanding to the management about the different weather patterns or conditions that normally affect Monasavu.

Stakeholders

FEA is the primary stakeholder for this bulletin. Their demonstration of interest in the usage of weather information initiated this relationship with FEA. Before the establishment of a monthly bulletin, FEA visited FMS, and the sort of information FEA requested helped FMS formulate a monthly product. Continuous discussions with FEA assisted FMS to gain feedback on the product. The lessons learned could also be used by FMS when looking at extending FMS services to other organisations that might also like to have FMS services, especially when working in line with the government of the day's objective of moving toward renewable energy.

Management

Since the beginning of the construction of the Monasavu Dam in May 1978, the management had decided to include a rain gauge, which started reporting in 1980. Since the beginning of the provision of the seasonal outlook for FEA, all the daily observation readings are carried out by the FEA officers based at Monasavu.

The programme commenced with monthly meetings, which often involved the manager of the CSD and the then Director of Meteorology. Several managers at FEA would attend the meetings, which were often held at FMS or at the FEA National Control Centre in Vuda. Additional meeting times, especially before the start of a tropical cyclone season or during an onset of an El Niño event (which often leads to drought for Fiji, depending on the intensity of the event), were called between both parties.

The usual contact point for FMS at FEA is Armogam Odaiyar, who is currently the 'Generation Dispatch Coordinator' for FEA.

Resources

The collaboration did not need much FMS infrastructure, but the guidance of the director and the analytical skills of the climatologists, together with the Seasonal Climate Outlooks in Pacific Island Countries (SCOPIC) tool, were needed to initiate the work. The data project also needed a great amount of assistance from the FEA management in terms of the usage of water in the dam for hydropower generation and the ability to analyse the Monasavu data before issuing a forecast for Monasavu.

Outcomes

Both FMS and FEA benefit from this partnership. FEA used the services provided to determine the plan for managing provisions of electricity for Fiji as a whole. FMS became recognised as the key climate information service provider for Fiji, especially with regard to linking meteorological services to development (electricity), safety, and security. This is particularly true in terms of the technical aspect of weather and climate, which are crucial for decision making. FMS is also mandated to be the provider of weather and climate information in Fiji.

The rainfall outlook includes information on Monasavu, the past month's rainfall, and the next three months and six months of rainfall. These data are compared to the long-term normal rainfall. The bulletin contains the current status of ENSO and the ENSO outlook for the next three months.

The monthly information provided to FEA also helps FEA to be in a better position to manage water in the dam and better maximise hydropower. For instance, in a 2015 Fiji Sun article, "Dry spell impact on electricity supply", the FEA chief executive Mr. Hasmukh Patel mentioned that Monasavu had six out of eight months of below or well below long-term average rainfall at Monasavu. The article shows how relevant information were used by FEA to manage the dam.

From the beginning of the relationship until today, FEA and FMS still communicate and collaborate on the monthly product. For information on the present El Niño Southern Oscillation (ENSO) conditions, previous consultations with FEA have helped to introduce the team to the various technical terms and enlighten the FEA on the current ENSO status and expected outcomes of the present condition. This information is important for FEA forward planning.

Lessons Learnt

Understanding forecasts versus reality and regional differences is important: Some challenges were found when trying to explain the favoured forecast to the users. In some cases, it is possible to have a forecast that favours normal or below normal rainfall but is not in line with what the conditions look like on the ground.

Data availability and quality are vital: Challenges arise when seasonal outlook models tend to have low confidence or low skills during certain periods of the year, especially during the dry season. It is during these scenarios that we tend to look at the current local conditions and try to relate them to the typical weather patterns that are normally experienced during those times of the year.

Poor record keeping is a limiting factor: All the documents regarding the beginning of the collaboration with FEA had no proper documentation, which made it challenging to describe the development of the FEA bulletin and relationship with FMS, requiring contact with some former FMS employees, those whom the author believed would have been involved in the birth of this collaboration and had insights into its success. A key action on this issue is to ensure proper documentation is being practiced.

Good partnerships are essential: The collaboration involves millions of dollars, as part of FEA's strategies to ensure provision of electricity for the nation. Good partnerships help both parties, and some of the strategies and lessons learnt from this partnership could be a learning platform for other national climate services.

Future

Weather and climate affect everybody, especially considering development planning and livelihoods management. FMS continues to provide FEA their seasonal rainfall and temperature outlook. In addition to a quarterly bulletin that FMS currently prepares for the Fiji Sugar Corporation, in terms of the rainfall and temperature outlook, FMS is also looking at working with the Ministry of Agriculture on a similar scale. A drought information bulletin is also currently being considered. Apart from the routine everyday forecasting information, these are some of the bulletins that are currently being provided or explored by the Climate Services Division, and their services do not end there. It is the combination of user curiosity and FMS expertise that helps everyone be better prepared for a safe and secure future.

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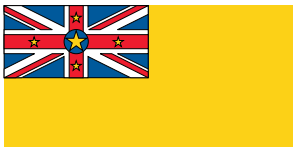
Water level observation is very critical. Photo: Adil Ali, Fiji Meteorological Service

Community awareness of climate services



Author organisation	Niue Meteorological Service
Contact person's name	Rossy Mitiepo
Contact person's email	Rossy.Mitiepo@mail.gov.nu
Providers of the service (including partners)	Niue Meteorological Service
Project timeframe	2009
Location	14 village communities, Niue
Primary target audience	Village members
Funding mechanism(s)	Pacific Islands Climate Prediction Project, AusAID, Australia

Summary

The Niue Meteorological Service (NMS) prioritised and conducted community awareness programs on climate services to ensure there is community awareness and buy in for the Niue National Strategic Plan (NNSP), with the vision 'A prosperous Niue – Niue Ke Monuina'. The NMS believes that improved and timely climate services have a role to play in achieving *Niue Ke Monuina*. Climate information awareness at the community level is important for better planning and informed decisions. Climate awareness programmes also need to be consistent and regular to sustain the knowledge of village members in communities.

Background

Most Niuean people are dependent on weather and climate information for the application of their traditional knowledge in planning for traditional events, such as haircutting, ear piercing, blessing of yams in May, and celebrating first-fruits of all crops in January. Climate forecasting started in 2005, and the information was developed in the form of an outlook. The Niue Climate Outlook (NCO) was then developed and disseminated through email reaching government departments, the private sector, non-government sectors, and village communities.

The NCO contains climate information that need to be explained and translated into the local language. Therefore, Niue Meteorological Service took interest and planned an awareness workshop for the 14 village communities. The workshop enhanced the understanding of climate information and helped communities to make informed decisions while at the same time increasing the profile of the NMS in providing essential climate services.

Methods

The community awareness project was endorsed by Cabinet, noting the funding source by the Pacific Islands Climate Prediction Project (PICPP, AusAid) and providing approval for the NMS to conduct the community workshops.

Village Council Chairpersons were consulted by NMS to discuss the arrangements of the workshop. Holding workshops in the evenings or during the weekend was considered appropriate and captured a wider audience. This time also allowed NMS staff to attend and fully facilitate the workshop.

Village members were informed of the workshop via radio, television, village e-mail list, or through the secretary of the village church because most village members also attend community events and gatherings.

Presentation materials on climate observations, data management, the Seasonal Climate Outlook for Pacific Island Countries (SCOPIC) tool, Niue Climate Outlook, tropical cyclones, and climate change for the workshop were prepared and delivered by the NMS. With knowledge acquired through regional and international training, NMS climate officers have the capacity to conduct the workshops. The workshop was conducted in both the English and Niuean languages.

Providing the facilitators with feedback about the workshop was useful and can be accomplished through a discussion group.

Stakeholders

The main stakeholders were village members in the 14 village communities. Stakeholders were approached by Village Council Chairpersons and their committee members through a village meeting, where they were informed about the community awareness workshop. The targeted population was everyone in the village communities in order to ensure that understanding on climate and weather knowledge was built at all levels. Those present were elders, farmers, women, and some employed workers, with a limited number of youth.

The feedback was summarised and made into recommendations. Comments posed by stakeholders were valuable and contributed significantly to further developments through the improvement of climate services. NMS was able to improve the climate outlook by including a Niuean translation.

Management

The project was a country-driven initiative funded by the PICPP in collaboration with NMS. The close coordination between NMS and PICPP fostered the initiation of an important awareness programme in educating village communities about climate services. This collaboration set the platform to recognise the needs for capacity building and improvement of climate services in NMS.

The workshop was evaluated through a feedback session with the village members. Having regular workshops was one of the needs identified by village members. These workshops would help the people in their communities retain climate science knowledge and apply it in their daily planning.

The project was managed by the NMS in close association with key stakeholders, essential for improved relationships in any future projects. In addition to the climate services information, this type of workshop provides an opportunity to share other work within the NMS, including awareness of weather, hazards, and climate change.

Niue Meteorological Staff presenting on weather, climate and climate change issues. Photo: Niue Meteorological Service

Resources

Successful community workshops required trained staff with sufficient time and resources to create presentations as well as readily available information covering all issues of the NCO. Information and graphics on weather, climate, and climate change obtained and developed through regional trainings were used as reference materials to help facilitate the workshop.

Local experts have the advantage of knowing the language and culture to understand certain protocols to follow when approaching a village community. The use of Niuean staff as workshop leaders raised the self-confidence and capacity of NMS staff.

Transportation, partnerships with leaders of the communities, budget, and timelines were important factors that were considered in the preparation process leading up to the workshop.

Use of a department vehicle as a means of transport to get to the village workshops assists staff to travel and arrive at the venue on time. Village meeting halls and church meeting halls were identified as appropriate meeting places due to their large space and specific design for such purposes. The budget was set according to locally driven initiatives determined by the NMS, which has years of experience working with village communities.

The Village Council Chairpersons and committee were the focal points to any of the village communities. Any programs introduced to the villages had to be endorsed using the contact points.

Relationships with the donors are important because workshop outcomes can become a stepping stone to more project developments in the future.

Outcomes

Village members became aware, and interest grew for regular climate services awareness programs. The NCO is a planning tool that informs people of a dry period, a drought, and a high-rainfall period. A local farmer might use the NCO to plan for a dry period and avoid cutting down the taller trees that provide protection over the small plants from the heat. The communities gained better understanding of the behavior of weather patterns, the difference between climate and climate change, and the channels of communication for tropical cyclone warnings and other hazards.

Partnership between the NMS and Village Councils were strengthened through trust, regular contact, and updates through e-mails as well as more involvement in pre-planning sessions.

Positive feedback was received from the workshops through discussions with the village members. They encouraged the NMS group to revisit them again and have the workshops run on a regular basis.

Lessons Learnt

The workshop was organised by 5 staff members of the NMS. Having all staff on board facilitating the workshop and conducting the presentations helps to deliver important information on all of the topics relating to the NCO.

The materials, equipments, stationeries, and venue for the workshop were an essential part of the workshop preparation carried out by the NMS. For workshop success, the funding must be identified and a budget planned prior to approval and implementation of the workshop.

Early consultation with Village Councils can help when planning appropriate times for workshops and promote the convening of the workshop and to gain a high attendance.

Holding a workshop during the evening or weekend includes a wider audience, such as more involvement from students, youth, and government workers, to allow more input in the discussions and to ensure more people will be reached and aware of what the NCO entails.

A small contribution in monetary value donated to the Village Council for refreshments during the village workshop is acknowledged and builds a relationship and trust. It is important to recognise the contribution of the village in the partnership with NMS. This relationship can become long term and makes it easier to communicate and bridge the gap for any future workshop.

Keeping to the schedule of meetings. Dates and times did not always go according to plan. It took about two weeks to complete the workshops:

Regular consultations with Chairpersons to ensure the meetings were held or changed if needed due to other village commitments. There were not many changes to the times and dates, and most importantly, the visits were completed within the necessary timeframe.

Simplifying scientific terms. Often, one technical term takes a paragraph to explain:

Staff speak Niuean and English, and their presentations were conducted in the Niuean language, making it easier for the audience to understand. The liberal use of diagrams and pictures also helped to further explain the terms.

Feedback and follow-up for the communities:

Recommendations by the villages were compiled into a report and submitted to Cabinet. NMS was able to respond to some of the needs of the communities, such as receiving the regular update of the NCO for their planning purposes. Some of the recommendations, such as the installation of a siren system, were implemented by another project.

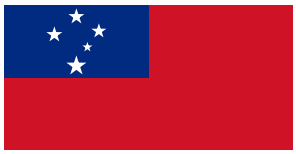
Future

The outputs of the project have been incorporated into the core business of the department. NMS has improved the way it presented some of its information in the NCO based on the outcomes of the workshop, such as translating the rainfall outlook into the local language. Education and awareness must be consistent and conducted regularly even after the allocated funding for the present workshops end. Imparting technical information for the people with one visit is not adequate, but a series of visits should be made each year so that the knowledge is kept and passed on to others.

Financial and human resources made it possible for the workshop to take place. Cooperation and coordination between NMS and the village council was established. Any future projects and programs planned would require financial resources to support their implementation.

Hikutavake village community taking part in the awareness workshop. Photo: Niue Meteorological Service

When every minute counts: Text messaging (SMS) to alert communities in times of disaster



Author organisation	Samoa Meteorological Division
Contact person's name	Tile Tofaeono and Mulipola Tainau Ausetalia Titimaea
Contact person's email	tile.tofaeono@mnre.gov.ws
Providers of the service (including partners)	Digicel and Meteorology Division-MNRE
Project timeframe	2012–ongoing
Location	Samoa
Primary target audience	MNRE management/Disaster Advisory Committee/Public
Funding mechanism(s)	Government of Japan and Government of Samoa

September 29, 2009, started like any other Tuesday morning, with grandmothers reheating the leftovers from the previous night's meal for breakfast while the kettle of freshly roasted koko (cocoa) permeated through the open fale. Little boys and girls rushed through morning chores in order to get to school on time otherwise the teacher may pick on them to read out loud in class.

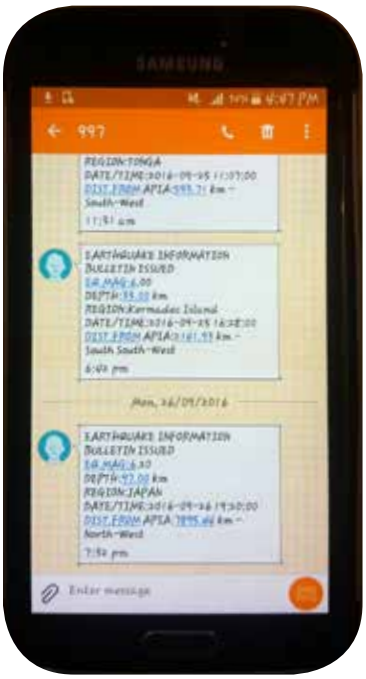
Then, it happened. The ground started to shake, the poles of the Samoan fale and the trees started to sway. Everyone immediately stopped what they were doing as it slowly dawned on them that it was a big earthquake. Ten minutes later, the ocean retreated briefly, just before a tsunami devastated the Samoan islands. There was no time for any official warning.

When disasters strike, they often come without warnings. Samoa is no stranger to natural hazards such as tropical cyclones, drought, and floods, which are becoming more frequent. The frequency and intensity of these disasters are severely impacting our agriculture, fisheries, health, and water resources.

After the 2009 tsunami claimed 145 lives, the need for a timely and reliable service to deliver accurate warnings became the main focus for the Samoan Meteorology Division (SMD). In the past, emails, radio announcements, website updates, and phone calls were the widely used methods of warning and information dissemination. These methods, while convenient and easily accessible by most government agencies and public servants, were not easily accessible by local communities.

Radio broadcasts in Samoa are one of the least expensive means of dissemination information and have the widest reach, but this option has its setbacks. Most radio stations are operational from 6 am to 11 pm daily, ruling out radio broadcasts as an option for any sudden after-hour emergency events. There is also the associated risk of people not getting the message because they are not tuned in or are sleeping late at night.

Feedback through ongoing consultations with communities, government agencies, and other sectors identified gaps in the SMD service. One of the priority requests was to diversify modes of communication so that other users and key responding agencies can receive warnings immediately. SMD was tasked to look into viable options for delivering a faster, effective method of communicating warnings.



Sample of SMS Alert. Photo: Luteru Tauvale, Samoa

Methods

In Samoa, the combined mobile network covers approximately 90% of the country. The majority of the population has access to mobile phones and subscribe to one of the two mobile phone carriers in the country. The SMD management in collaboration with the Bluesky and Digicel mobile networks started to work together to explore options to send warnings faster. Text messaging was first explored under Bluesky and Digicel's Corporate Social Obligation arrangement and was an initiative by Mulipola Ausetalia Titimaea, the director of SMD. During the initial stages, only pre-written earthquake and tsunami warning texts were set up within Bluesky and Digicel's systems. When an event (earthquake or tsunami) occurred, the duty SMD operations officer would call the Bluesky and Digicel numbers to activate the warning texts. The whole process would take more than 20 minutes before the first message was activated and received.

In 2010, funding from the Government of Japan through the Japan International Cooperation Agency came through to install a new forecasting and early warning system. The new robust warning system (IBL) allowed the addition of all natural hazards, including weather and climate information, into the system with additional functionality of tailor-made messages specific to individual events and the capacity to send messages simultaneously either as SMS or pdf through emails, fax, and cellphones. The new system has a much faster and wider-reaching service than other communication options and is operated directly from the SMD headquarters at Mulinuu. The new system now takes less than 5 minutes for a text to be sent from the SMD to the end user. This is much faster than the 20 minutes through Bluesky and Digicel SMS. This speed is important: it was only 10 minutes between the felt earthquake and the first tsunami wave strike in 2009.

Management

In refining the text messages, updating, and testing the system, SMD worked closely with the Disaster Management Office, Fire and Emergency services, Ministry of Police, Ministry of Women, Community and Social Development, Digicel, Bluesky, and civil society.

Resources

Resources required for this system to work include the continuous training of SMD staff to interpret weather and disaster-related content into concise community messages, based on the forecasting system. Standard operating procedures for SMD were revised to govern the use of the system and the text messaging process. Continuous support from cell phone providers is crucial as well as the assistance from donor partners and other stakeholders to continue engaging communities to raise level of awareness in understanding and interpreting messages.

Outcomes

The system is fully operational for weather (tropical cyclone) and tsunami alerts and has been tested annually in partnership with the National Disaster Advisory Committee during National Disaster awareness events and the tsunami regional PACWave exercises, a bi-annual testing exercise for both procedures and communications.

Although the system has not been tested nationally in the context of a slow-onset event, the SMS messaging system is tested occasionally. SMD runs test messaging within the Meteorology staff, and SMD sends out text messaging information on real events to MNRE management and DAC members during village drills. One villager commented that "being able to receive the text message through my phone reduces my stress level and panic mode; the more messages I received from the Weather Office, the better I get in planning my actions and has made me and my family more prepared for earthquakes."

Others have said that their families do not have any radios, only TVs, and the only way they know something is happening is when they watch the news at night; therefore, using text messages is the only way for them to get warnings outside of the news broadcast in the evenings.

To improve the system and SMD's service, feedback and responses from staff members and the public are often requested and captured primarily via email or telephone calls. Some people have also raised their concerns through radio programs, newspaper, and social media on the Facebook platform. Most of the feedback has been positive, with some constructive criticism which we have been using to continuously build the system.

> "Being able to receive the text message through my phone reduces my stress level and panic mode; the more messages I received from the Weather Office, the better I get in planning my actions and has made me and my family more prepared for earthquakes."

Lessons Learnt

- The new system has enabled the SMD to provide the right information reaching people instantaneously and has lifted SMD's visibility as the official source of warnings.
- The use of the system has reduced the damage from misinformation that is usually spread through social media.
- The use of the latest technology to convey important information to users means that we reach more people with the best message from the right source.
- The use of alternate media and the flexibility of creating messages for different audiences has resulted in positive capacity building within the SMD.
- The linkage between sectors, agencies, and communities is stronger with fast, reliable connections.
- Lessons learned from the texting capability of the system can be replicated and improved on by other Pacific Meteorological and Warning centers; for example, Vanuatu Geohazards developed their text messaging warning capability based on lessons from Samoa.

Challenges/Lessons learned

- There are limitations to the number of characters available for 1 SMS message, requiring concise messages. Samoan language SMS are sent in addition to English SMS, with different lengths, and messages in the two languages are sent separately. The willingness of Digicel and Bluesky to donate this messaging in emergencies is integral to project success, without a doubling of the cost.
- The present system has a limited number of recipients; thus, the system might get congested at some stage.
- The present system relies on Digicel only for sending SMS, with 50% of Samoans with mobiles subscribed to this company. There is close collaboration with Bluesky to also have this service available through its network soon.

Future

- The SMS system is an ongoing programme that is now mainstreaming into SMD's everyday work through the support from the government.
- Government agencies, non-governmental organisations, and partners have developed strategies to work in tandem in order to strengthen the communication of messages to communities. In that way, each sector can concentrate on their mandate and focus on the effect of communities from their point of view.
- Climate change and disaster risk management plans with partners will be updated to incorporate the use of the SMS system, informing the key community members involved in risk management during an emergency.
- Ongoing discussions with Bluesky and Digicel are continuing regarding the option of cell broadcasting to complement the texting feature of the warning system.

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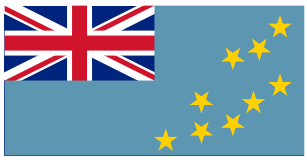
Aftermath of the 2009 tsunami in Samoa. Photo: S.Sawano Samoa Meteorological Division

Communicating climate information to communities



Author organisation	Tuvalu Meteorological Service
Contact person's name	Mr. Tauala Katea Mr. Elifaleti Ene
Contact person's email	tauala.k@gmail.com
Providers of the service (including partners)	Tuvalu Meteorological Service, Tuvalu Red Cross, Tuvalu Disaster Management Office, the Secretariat of the Pacific Regional Environment Programme (SPREP), International Federation of Red Cross and Red Crescent Societies (IFRC), Tuvalu Media Department, Australian Bureau of Meteorology
Project timeframe	2013–2015
Location	Teone village, Funafuti, Tuvalu
Primary target audience	Teone village, media, youth
Funding mechanism(s)	Finnish-Pacific Project (FINPAC) Climate and Oceans Support Program for the Pacific (COSPPac)

Background

Large boulders thrown onto the narrow road and in front of houses have become a normal sight in Teone village, Funafuti, but pose a threat for the people. Winds from the west generate waves and storm surges that carry those boulders to Teone's shores. Most of the people living in Teone are from outer islands seeking jobs and other socio-economic opportunities. People living in Teone and on the main atoll of Funafuti use weather and climate information for decision making especially for fishing and moving their fishing boats to safety when there are strong wind warnings.

A baseline survey on weather, climate information and traditional knowledge usage was commissioned in July 2014 with the help of the Tuvalu Red Cross. The results were used to inform the planning of a 4-day Climate and Disaster Resilience Planning Workshop in July as well.

Methods

The baseline survey for Teone took 2 days to cover all 80 households. Then, the Climate and Disaster Resilience Planning workshop was held at the Vaitupu community hall and was conducted in Tuvaluan.

An introductory meeting with the village was held a day before the workshop to introduce the partners and present the programme. The village then confirmed 30 participants who were carefully selected to ensure that there was good representation of men, women, youth, and people with disabilities.

The workshop followed the process of community assessment, community planning, and creation of a community plan of action. Representatives from the Tuvalu Meteorological Service (TMS) presented the types of information that TMS can provide and clarified terminology. An interactive Community Vulnerability and Capacity Assessment process was used to draw out information such as a spatial map of the village, resources available, historical events, and a seasonal calendar for the development of the CCDRP (Community Climate and Disaster Resilience Plan).

Following the workshop at Teone, a 2-day Media Training was held for the TMS and the local media, to bring them together to share information about what they do and discuss ways of collaboration to better communicate weather and climate information through the media. Tuvalu Media Department staff particularly benefitted from understanding the terminology used in climate information before broadcasting to the public.

Stakeholders

A range of stakeholders were involved in these activities, including villagers from Teone. The Media Training included TMS staff who work as observers, forecasters, climatologists, and technicians as well as the Acting Chief Meteorologist. Staff from the Tuvalu Media included reporters, announcers, and the General Manager. The CCDRP workshop was facilitated by the National Coordination Team (NCT) comprising the Tuvalu Red Cross, TMS, and the National Disaster Management Office. Technical support was provided by the International Federation of Red Cross and Red Crescent Societies (IFRC) Fiji and by SPREP. The Communications and Outreach Adviser from SPREP facilitated the Media Training.

Management

The workshop gave TMS the opportunity to share its information with communities and get their feedback on how to best tailor information to suit their needs. The TMS now plans to seek funding from Government and other partners to replicate this workshop and community consultation to other villages on Funafuti as well as outer islands.

Partnerships with other Government agencies are also being sought by TMS with the second workshop held in 2015 in collaboration with the Public Works Department.

To address language issues raised during the workshop, the monthly Climate Bulletin is now translated into Tuvaluan by the Climate Team.

Resources

In addition to funding support provided by the FINPAC Project for the baseline survey and workshop costs, the support from the Government of Tuvalu through the TMS and the Disaster Management Office is vital for these activities. In-kind contributions from the NCT for the planning and facilitation of the workshop were important. While funding for the small pilot project is provided by FINPAC, the sustainability of this work is dependent on the political will, community ownership, and buy-in and commitment of all. The use of Red Cross branches and volunteers to support community awareness is invaluable support for the TMS.

Outcomes

- Improvements have been made to the monthly Climate Bulletin, which is now being translated in Tuvaluan. TMS also holds monthly radio programs to explain the bulletin.
- A Community Climate and Disaster Resilience Plan for Teone has been developed.
- A Facebook page for TMS was developed to update the public on climate information. The Climate Officer updates the site every morning.
- Stronger relations have been formed between the village and TMS: fishermen physically turn up to the office to get weather bulletins and tide information.
- Stronger partnerships have been established between TMS, Red Cross, Tuvalu Media Department, and the Disaster Management Office.

Lessons Learnt

The CCDRP workshop in Teone was a good approach for obtaining user feedback from communities.

Meteorological information is very technical. For it to be meaningful, this information has to be simplified and translated in the local language. This should be supported by ongoing awareness programmes for communities and other key stakeholders.

Weather and climate information is essential for socio-economic development.

Communicating meteorological information is a challenge. The media is a powerful tool; therefore, it is important to build professional and personal relationships with media workers.

A glossary of meteorological terms needs to be developed and shared.

Lack of feedback on TMS products (weather and climate information)

TMS needs to engage more with users to get feedback to improve its services.

TMS proactively seeks user feedback through partnerships with government agencies, climate change projects, and community projects.

The English and Tuvaluan terminologies used in weather and climate bulletins are very technical

Work with partners and stakeholders to develop a glossary and ensure that the language is simplified.

TMS to work with the media to have monthly radio programmes to raise awareness of users on the glossary.

Households lack access to radios to access information

Create a Climate Board where information from TMS will be displayed on a weekly basis using printed bulletins.

Procure solar radios for households of Teone.

Future

TMS plans to host a national Climate Outlook forum in Funafuti to bring together all sectors to share information and discuss ways to improve access to and quality of weather and climate information. TMS also plans to seek funding support to replicate the FINPAC community workshop in the outer islands.

Partnerships between TMS, the Tuvalu Red Cross, and the Disaster Management Office need to be formalised through a Memorandum of Understanding. TMS has committed to help Teone village with its climate board by ensuring that the information is updated daily. A second visit to the village to collect their feedback on the progress is also important. In this way, TMS and the village will work together for a safe, effective response to weather events.

Teone village is highly exposed to inundation and swells, especially from the ocean side. Photo: Tusi Finikaso, Tuvalu Red Cross Society

Teone Disaster Committee undertake Emergency Response Training as part of the pilot project implementation phase. Photo: Tusi Finikaso, Tuvalu Red Cross Society

Collaboration to strengthen climate services: the Vanuatu Climate Action Network

Author organisation	Oxfam in Vanuatu
Contact person's name	Daniel Vorbach
Contact person's email	danielv@oxfam.org.au
Providers of the service (including partners)	Vanuatu Climate Action Network (VCAN) members
Project timeframe	Phase 1: 2012–2015 Phase 2: 2015–2017
Location	Port Vila, Vanuatu
Primary target audience	Civil society organisations and the communities they work with across Vanuatu
Funding mechanism(s)	Phase 1: Oxfam Australia Phase 2: Oxfam America

Summary

The Vanuatu Climate Action Network (VCAN) is a network of civil society organisations working to improve communities' resilience to climate shocks, stresses, and changes. Part of VCAN's work is to support civil society organisation members and Vanuatu's Meteorological and Geohazards Division (VMGD) to develop and provide consistent information about and communication of weather, climate, and climate change. This information and knowledge serves to support household and community planning and actions to reduce disaster risk and adapt to climate change.

Background

Prior to 2012, it was common to have confusion and lack of coordination among communities and civil society organisations on climate change and disaster risk concepts which hampered efforts to achieve effective mobilisation of climate action to women, men, boys, and girls. The VCAN was then formed in 2013 through the *"Yumi stap redi long klaemet jenis"* program, or the Vanuatu NGO Climate Change Adaptation Programme. The network, convened by Oxfam, was formed to address the lack of coordination and collaboration among civil society organisations and the government of Vanuatu on climate change issues. The network also provides a channel for community voices to reach national decision-making fora. One key issue driving greater coordination was the need for consistent communication of weather, climate, and climate change information.

Methods

VCAN was formed in early 2013 by a group of civil society organisations in response to the need for increased coordination on climate change adaptation policy and practice. The objectives for the creation of VCAN were to:

1. enable civil society organisations to share technical expertise and experience, and
2. collectively discuss and engage with government policy and legislation, rather than communicating individually with the government.

A core group of agencies submitted a concept to the Australian Government for a joint project, which included the establishment of a civil society network. The proposal was successful, and Oxfam was nominated to play a secretariat function for the network, given its expertise in network coordination and facilitation.

VCAN engages more than 20 civil society organisations to share lessons and good practices for supporting community adaptations to the impacts of climate change. VCAN shares these findings with the Government of Vanuatu and international stakeholders to inform decision-making about climate change adaptation. VCAN's membership includes national NGOs, like the Vanuatu Christian Council and Vanuatu Rural Development Training Centres Association, and international NGOs, such as CARE International, Save the Children, and Oxfam. The Vanuatu Red Cross Society also participates in VCAN meetings. Any NGO in Vanuatu working on, or interested in, climate action can join the network.

A strong network was built through monthly in-person meetings, biweekly VCAN email digests sharing key resources and information with practitioners across the sector, presentations from visiting academics and practitioners, and the creation of a shared sense of ownership over the network through inclusive facilitation. Mobilising its members in these ways, VCAN provides an effective forum for government and non-government agencies to learn from and consult with civil society.

VMGD staff regularly attend VCAN meetings. These meetings are held every two months, usually at Oxfam but sometimes rotating at members' offices. They are attended by practitioners, and as such, discussions are mostly held in Bislama. VMGD staff present and explain the latest Vanuatu Climate Update (see 'Outcomes') and answer questions from VCAN members about its content and communication of its content. This regular interaction supports VCAN members, mostly Ni-Vanuatu project staff, to relay accurate and consistent climate information to men, women, and youths who plan their lives and livelihoods in response to likely weather and climate conditions. Through ongoing dialogue within these meetings, VCAN also enables VMGD staff to better understand the information needs of communities and the agencies communicating with communities for continuous improvement of climate services. VCAN feedback has been used to improve the Climate Update template and to stimulate the inclusion of a glossary in Bislama to clarify key terms used.

The VCAN email digest, regularly sent to over 70 people, contains important links and updates of interest to civil society. The digest provides links to new Climate Updates, encouraging practitioners to take the Climate Update to communities and explain its information. By packaging climate updates in an interesting and engaging newsletter format that reaches NGO staff directly, the digest spreads climate and weather information to a wider audience of practitioners. VCAN recently started using email management software to track analytics for open rates and click rates that will inform ongoing improvements in the presentation and content of future email digests.

Management and Resources

VCAN was funded through Oxfam Australia until February 2015. It is now funded through Oxfam America until 2017. Oxfam is the secretariat for VCAN, and a full-time VCAN Coordinator role has been essential to facilitating relationships and brokering information between members and with the Government of Vanuatu.

The funded secretariat role and an energetic, inclusive network facilitator have been critical to the network's success. To create shared ownership and commitment by members, no single agency's name or influence is dominant in the network. Members annually meet to jointly reflect on achievements, challenges, and lessons and to develop plans for the coming period.

Outcomes

As a network, VCAN enables the consolidation of skills and experience in implementation of climate change adaptation and disaster risk reduction. VCAN also supports a strong understanding of the needs and priorities of women, men, and young people at the community level gained through regular exchange of lessons between organisations on their work with communities and the experiences of different community members.

Improved coordination by a range of local and international organisations through VCAN has allowed more systematic contributions to government policy development. VCAN has been welcomed and recognised by the government of Vanuatu, holds a seat on the National Advisory Board for Climate Change and Disaster Risk Reduction, and is now seen as a key consultative body in climate policy and practice development nationally. Members have asked women, men, and young people in the communities they work with a common set of questions about their experiences and priorities, which have informed VCAN's positions, the National Climate Change and Disaster Risk Reduction Policy, the National Sustainable Development Plan, and Vanuatu's engagement with the United Nations Framework Convention on Climate Change (UNFCCC).

Various VCAN initiatives have specifically focused on improving climate services and communication of weather, climate, and climate change in Vanuatu to communities through the civil society organisations they engage with. VCAN was a key stakeholder in the development and implementation of the Klaod Nasara toolkit[1]. Through VCAN, the toolkit developers were able to incorporate lessons from a large number of agencies to ensure that the toolkit was contextually appropriate. By tapping into its network of a broad range of actors interested in communicating about weather, climate, and climate change, VCAN was an effective forum to train and share information between agencies on their use of the toolkit and communication achievements and challenges.

The Vanuatu Climate Update (VCU) is a regular public communication document released by the VMGD on seasonal forecasts. The VCU is posted on the VMGD website and also distributed to civil society organisations through the VCAN email digest. Civil society organisations then play a key role in disseminating the update to communities by handing out the Bislama document (e.g. posting on community noticeboards) as well as explaining the content of the update in plain language and demonstrating what it means for people in planning their lives and livelihoods.

VCAN was part of an overarching programme evaluation at the end of 2014, which commended the work of VCAN in increasing awareness of climate change and collaboration by NGOs, government, and other stakeholders. The evaluation reported, *"Drawing on the collective experience and specialist skills of individual agencies, consortium partners and the wider network have greater capacity in climate change adaptation programming...VCAN members have access to climate change information relevant to Vanuatu through an average of three VCAN email digests per month; providing selected updates of direct relevance to VCAN members"* (Sterrett, 2015).

A social network analysis conducted by the Secretariat of the Pacific Community (SPC) and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) in 2014 evidenced the importance of VCAN in linking actors in the resilience sector with each other and the government. Subsequent data analysis found all but four of 260 people in the social network analysis linked to VCAN (Vachette, 2014). VCAN did not need to do active outreach to gain these connections due to the relatively small size of the sector/country.

Oxfam supporting VMGD reprinting of ENSO handbook for distribution to farmers during the 2016 community base climate field schools in Penama and Malampa province. Photo: Philip Malsale, Vanuatu Meteorology and Geo-Hazards Department

1 A toolkit of materials developed to raise awareness of the science and impacts of El Niño and La Niña in Vanuatu and of preparedness actions that people can take. Klaod Nasara was a collaboration between Red Cross and the Australian Government's Pacific-Australia Climate Change Science and Adaptation Planning (PACCSAP) Programme.

Lessons learned

VCAN-style networks can only work when there is a shared commitment and openness among civil society organisations and the government to work together to achieve collective impact.

VCAN demonstrates the value of collaboration and information-sharing to the development and implementation of climate services. VCAN provides an effective way for the VMGD to engage with civil society and understand community information needs. This is particularly relevant for small island developing states where government services and communication to remote islands is limited and civil society is a key vehicle for bridging this gap. However, the facilitation and secretariat role does require funding investment to maintain network relationships and momentum between meetings.

A strong relationship between the network and the VMGD has been crucial to enable feedback loops to improve information flows and contents, for example in the language of the VCU, the content of the Klaod Nasara animation, and the placement of community-based adaptation at the centre of the National Climate Change and Disaster Risk Reduction Policy.

Future

VCAN's future will be determined by the interests and needs of its members and stakeholders. VCAN's plans for supporting climate services in the near future include close collaboration with VMGD, the National Disaster Management Office, and the sectoral clusters involved in disaster management, to establish and implement consistent messages for communicating with communities on the El Niño situation along with suggestions on how to prepare for and respond to low rainfall.

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VMGD officer, Albert Wily presents ENSO handbook and Tropical cyclone map to Neramb primary schools in Malekula, Vanuatu during the provincial El Nino and La Nina awareness program in 2016. Photo: Philip Malsale, Vanuatu Meteorology and Geo-Hazards Department

Vanuatu Climate Field School

Author organisation	Vanuatu Meteorology and GEO-Hazards Department
Contact person's name	Philip Malsale
Contact person's email	malsale@meteo.gov.vu
Providers of the service (including partners)	Vanuatu Meteorology and GEO-Hazards Department, Department of Agriculture and EU-GIZ (Vanuatu)
Project timeframe	2012-2013
Location	Vanuatu
Primary target audience	Farmers, Vanuatu Rainfall collectors, Students
Funding mechanism(s)	EU, EU-GIZ, Australia, Vanuatu Government

Summary

The Vanuatu community based Climate Field School (CBCFS) provides technical know-how on agriculture sector adaptation in Vanuatu. It provides a platform wherein extension officers from the land-based sectors (agriculture, forestry and environment) and key farmers will directly engage with agro-meteorologists to share ideas about important agrometeorology indicators. It is also an avenue where the important linkages and factors between meteorology and agriculture are discussed in detail with a view of providing the best advice for the agricultural sector. As Vanuatu continues to mature in its response to and preparation for climate change risks, stakeholders have called for more hands-on practical trainings on the adaptation strategies. In addition, stakeholders would like to see written and audio-visual materials developed for use in extension work by government and non-government agencies, which the Climate Field Schools will deliver. As the manager of the Vanuatu climate division said, "*This programme is a great example of differentiating climate services from climate information. All along people talk about climate services, but unless climate information changes the way people live and do things in the local communities, then National Met Services are only providing climate information.*"

Background

A community-based Climate Field School is an initiative that involves taking climate information to 'champion' farmers to aid decision making at the community level. This initiative was developed because the climate information in Vanuatu provided by the Meteorology and Geo-Hazards Department (VMGD) is not fully used to influence people to make decisions at the community level. For example, the seasonal tropical cyclone outlook for 2014/15 clearly outlined a possibility of a tropical cyclone of category 5, similar to tropical cyclone Uma in the 1986/87 cyclone season. Although this information was put out to the public six months before the event actually happened, people did not take it seriously to use the information for preparedness.

The Climate Field School also addresses the need for developing capacity at the community level to carry out observations, such as rainfall observations from the Vanuatu Rainfall Network, and to link these observations to the climate products, such as the Vanuatu Climate Update, and to find ways that this information can help communities make simple but important decisions. An efficient way to address these gaps is to run Climate Field Schools in the communities so people can learn climate science and information, engage, and observe best practises to help improve their lives.

The Climate Field School includes training on topics such as likely climate futures of Vanuatu, climate outlooks—including El Niño and La Niña—and tropical cyclone seasonal outlooks. This training helps participants understand the science and how it links to real life situations in their communities. One linkage to real life is teaching farmers about the Vanuatu Climate Update and determining the practices to be used in their farms. The farmers are then taught best practices for coping with climate stress relevant to their livelihoods needs and adaptation activities, such as:

- taro, yam, and banana culture;
- cattle, chicken, and piggery raising and feed;
- backyard tilapia farming;
- agroforestry;
- coastline rehabilitation; and
- climate science and data collection.

Methods

This initiative began in recognition of the great impact that climate information can have when it is used by local communities in their decision-making, particularly when it comes to low-cost activities that can improve their lives. A key part of the Climate Field School is clearly linking climate information to the normal daily activities of communities.

Training is delivered through a partnership approach where multiple government departments (including agriculture, livestock, quarantine, fisheries, environment, meteorology, and the donor agency Deutsche Gesellschaft für Internationale Zusammenarbeit [GIZ]) pool resources and materials to carry out community training, demonstrations, and relevant activities.

Vanuatu national Agro-Met summit in Tanna including agro-met roadmap strategy and climate field schools. Photo: Philip Malsale, Vanuatu Meteorology and Geo-Hazards Department

The agro-meteorology summit in Luganville in 2012 showed that the biggest gap since the first summit was that capacity building and information provided by the VMGD had not translated to action at the community level. Based on this finding, the Climate Field School approach was modified to train 'champion' farmers from each island who would then be able to influence other small farmers and their communities because small-scale farmers will look up to the champion farmers and be eager to learn their success. The selection of the champion farmers was based on the consistency and scale of their activities. If a farmer was specialised in piggery or yam farming, then he/she was selected to attend the Climate Field School.

The Climate Field School has been very successful and a lot of improvement has been observed since it started. Each 'school' consists of formal presentation on climate science and the products of VMGD. Other departments present the products and services they provide. During the School, the VMGD products are explained in detail to show how that product can help with decision making for farmers. For example, if the Vanuatu climate update provides information of a possible El Niño event, then farmers are taught to plant in appropriate locations, such as close to river banks, with appropriate planting material at appropriate times. At the end of the workshop, manuals, video clips, and demonstrations of agricultural plots about certain activities are put together as user guides.

The Climate Field School follows this format:

- Meteorology, climate, and climate change: Theory
- Agrometeorology, livestock, forestry, environment, and food security: Theory
- Practical Field School Exercises in agrometeorology, livestock, and forestry:
  - Yam Miniset Technique
  - Yam Vine Replication
  - Manioc Seeds
  - Taro Sexual Reproduction
  - Glyricidia
  - Mucuna
  - Organic Pesticides
  - Banana Preservation
  - Samoan Banana Replication
  - French Banana Multiplication
  - Pig Food Silage
  - Backyard Tilapia
  - Forest Nursery Establishment and Maintenance
  - Grafting/Budding
  - Composting
  - Establishing and Registering a Community Conservation Area
  - Land Use Planning

Practical session on how to set up a forestry nursery in Tanna during the climate field school. Photo: Philip Malsale, Vanuatu Meteorology and Geo-Hazards Department

Stakeholders

The stakeholders are mainly government departments, including agriculture, livestock, quarantine, fisheries, environment, meteorology, and donor agencies, such as GIZ. The members were chosen because the climate division wanted to ensure that land-based sectors were included: those that are affected by climate variability and change, with negative impacts on the socio-economic livelihoods of people in Vanuatu.

The participants are mostly champion farmers who have started a small-scale project of their own, such as coconut plantations or cattle ranging. The selection of key farmers is used to ensure that main priority areas in each sector are represented. The collectors in Vanuatu's rainfall collection network are also part of these trainings. They form a network of 84 volunteers who collect rainfall data and are focal point for VMGD in those communities. Schools that have senior-level students and that are close to the venue are also invited to attend demonstrations.

Management

The project was funded by the Vanuatu government, Australian government, and the European Union (EU). There are some other Climate Field Schools funded by EU-GIZ (in the Vanuatu office). There are different donors for different field schools, but the format is the same depending on the participants. The Climate Field School is a big exercise and needs careful planning.

Resources

Several resources are needed to carry out a Climate Field School.

Funding: VMGD with the assistance of donor partners contributed financially to host a week-long Climate Field School with over 100 participants. Especially considering the need to transport people from different islands to the training location, expenses will be high for transportation but will be better if this activity is implemented with partners.

Human resources (expertise): VMGD works with multiple government departments and the donor agency GIZ to pool resources and materials to carry out community activities and the Climate Field Schools.

Venue: VMGD uses schools or community halls in communities close to the coast, which have the most resources that can be used during demonstrations. Sites that are close to an agriculture station are ideal. It is also important to engage with schools.

Materials (class and demonstration): The materials for demonstration are the key to the success of the Climate Field Schools. Therefore, it is important that funds are allocated to transport materials from other areas for islands if the materials are not available in the field school venue.

Video/sound system: It is best to use a sound system (PA system) if many people are invited. Video recordings of the demonstrations are important.

Outcomes

The Climate Field School primary targets are the sectors of agriculture, forestry, and environment. The developed products, such as training guides, videos, and seasonal planting calendars, benefit those involved in this sector, mainly the champion farmers and local schools located in the vicinity of the training. The products developed from this programme are available in soft and hard copies to the public.

The key achievement that resulted from the Climate Field School initiative is the increased enthusiasm from farmers and students, who now understand more about why climate information is important and the linkages between sectors (such as agriculture) and climate. Communities requested to have notice boards erected to show climate updates, people have started backyard tilapia projects, and farmers have started yam multiplication on specific low-supply yam species and using certain taro breeds that grow well on different islands.

One particular positive result from this programme is a palm seed variety planted in Tanna to give communities another option for traditional roof material, which is longer lasting than what communities are currently using. This change demonstrates the increased understanding of the community as a result of the communication efforts of those champion farmers that attended the Climate Field School.

The project was evaluated through an attendance and activity evaluation contacted by a consultant.

Lessons Learnt

Establishing climate information as part of decision making in the different sectors is a major challenge although very much needed, as demonstrated by this initiative. Keeping enthusiasm and trust among agencies and with communities is another challenge that often arises regarding the accuracy and timing of information, and this is slowly changing as communities realise the importance of information and preparedness and the reliability of their VMGD. The other big challenge is maintaining accessibility to climate information and continually developing capacity at the community level to understand this information.

Though there may be challenges, as outlined below, this programme is a breakthrough example of how partnerships can take climate services to the level of communities.

Helping farmers to understand climate science and services: It is a very difficult challenge to make farmers understand climate science and link to their village activities. To address this issue, VMGD through the climate division with the help of partner organisations developed two short animations called the ‘klaod nasara’ and ‘climate crab’. The klaod nasara is Vanuatu-related, whereas the climate crab animation has more of a Pacific focus. The klaod nasara animation features local characters with local settings and activities that connect climate and weather activities to the daily lives of people in Vanuatu. It emphasises the impacts of ENSO and how people can minimise the negative impacts. The animation is in Vanuatu’s three official languages—Bislama, English, and French—and comes with a toolkit. During the agro-meteorology summit, Klaod Nasara toolkit was identified as one activity that requires a lot of good planning to ensure that people really understand before the beginning of field schools. Therefore, every activity in the field school is related back to the services and products of VMGD regarding climate science.

High costs: It is certainly a costly exercise to bring all successful farmers from all over Vanuatu to one location to run the Climate Field School. The resolution from the 3rd agro-meteorology summit in Tanna in 2013 was that there will be a change in the approach to cut costs: a technical team will be formed who will represent all the stakeholders of the Climate Field School, and this team will travel to villages to carry out Climate Field Schools.

Linking champion farmers to other farmers in one area: It has been realised during the past two agro-meteorology summits that there has been very little progress made by champion farmers and provincial agricultural officers to transfer the knowledge gained during the Climate Field Schools to other farmers in their area. Therefore, the formation of a technical team will ensure that all farmers in a village or community in Vanuatu will benefit from the community-based Climate Field Schools.

Working in silos will not make each sector progress. The realisation is growing that Vanuatu's economic development is dependent on timely and accurate weather and climate information and services. If this knowledge spreads well to all sectors, there will be a lot of progress in transforming climate information to climate services and to community development.

Working together with the stakeholders and pooling resources is important to make an impact at the community level. Going far down and deeper into the communities to understand their needs so that we can develop climate products that meet them is important, and the outcomes reflect that a bottom-up approach is appropriate when implementing this programme.

Confronting the unknown and using lessons learned from other countries is the best way forward. The work that has been done provides a baseline to move to another level of engagement.

There is a greater need for the climate division to provide services to specific sectors rather than general climate information alone. The demand for this is increasing as other sectors, such as marine and health, see the benefits from Climate Field Schools and come forward with their own requests.

Future

Vanuatu will continue to participate in Climate Field School training in Indonesia and other countries in the coming years, and perhaps this training could be something for other Pacific island countries to consider. This training will build human resources to implement these activities in Vanuatu in the future.

The way forward as recommended during the 2013 Tanna agro-meteorology summit is to set up a technical team to visit communities to run Climate Field Schools at lower costs. The idea of forming a technical team to replicate the Climate Field School for other provinces is not only to reduce the cost but also to spread the technique to more people and more communities. This team will consist of technical people, at least 10, from agriculture, fisheries, VMGD, environment, forestry, quarantine, livestock department, and GIZ to travel to communities and run the Climate Field School. In this way, not only will the champion farmers benefit but also the whole community will benefit, including school children, women, and the elderly. This approach is a more collective approach that is less expensive and that will help the community to learn and work together to build resilience in their community.

Building climate- and disaster-ready communities through improved national meteorological services: the Finnish-Pacific (FINPAC) project approach

Author organisation	International Federation of the Red Cross Pacific Regional Office, Red Cross Red Crescent Climate Centre, and Secretariat of the Pacific Regional Environment Programme (SPREP)
Contact person's name	Lesu Waqaniburotu and Christina Leala-Gale
Contact person's email	lesu.waqaniburotu@ifrc.org; christinal@sprep.org
Providers of the service (including partners)	Government of Finland, SPREP, International Federation of the Red Cross, Red Cross Red Crescent Climate Centre, Pacific Red Cross National Societies, Pacific National Meteorological Services, Pacific National Disaster Management Offices
Project timeframe	2014–2016
Location	The scope of the project is regional in 14 Pacific island countries with the community component focusing on eight: the Cook Islands, Kiribati, Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu
Primary target audience	Selected vulnerable communities in each of the eight countries
Funding mechanism(s)	Government of Finland, Environment Canada, and World Meteorological Organization through SPREP

Background

Pacific island countries are experiencing the impacts of climate change, particularly through effects on the intensity and frequency of extreme events. Climate change may affect the intensity of tropical cyclones, the most recent being Tropical Cyclones Winston (February 2016) and Pam (March 2015) and Typhoon Maysak (March 2015), all Category 5 storms that struck Vanuatu and the Federated States of Micronesia.

Pacific island countries are primarily dependent on weather- and climate-sensitive activities for their social and economic survival—be it through fisheries, subsistence agriculture, or reliance on other natural resources. Natural hazard impacts exacerbated by climate change pose a serious threat to community livelihoods. It is thus imperative that community capacity is strengthened to enable them to receive, interpret, and apply relevant weather and climate information for planning, preparedness, and response. Thus, potential losses are minimised and managed. Increases in the risks associated with many climate-related hazards due to climate change further increase the need for communities to be able to systematically use climate information to prepare and adapt.

National Meteorological and Hydrological Services (NMHS) are mandated to deliver weather and climate information to help communities prepare for and minimise or ideally avoid the impacts of these hazards. There is an increasing requirement for NMHS to provide information that is relevant and suited to the needs of its users and to reach those who are socially, physically, or economically isolated. Unfortunately, few NMHS in Pacific island countries have the resources or capacity to engage directly with users to understand their needs and deliver user-relevant products and services.

The 'FINPAC Project on Reduced Vulnerability of the Pacific Island Countries' Livelihoods to the Effects of Climate Change' has a three-pronged approach to help communicate meteorological information and services to different audiences: (i) strengthening national media capacity by increasing understanding

of Pacific meteorological terminology to ensure information shared through the media is factual and correct; (ii) strengthening the communication skills of NMHS staff to best communicate information so the relevant audiences can understand and respond accordingly; and (iii) strengthening capacities of communities to understand and use information for decision making.

Methods

Through an inclusive and participatory approach, the Project aims to engage and foster effective communication and partnerships between the NMHS, National Disaster Management Offices (NDMOs), Red Cross Societies, local communities, and other key stakeholders. Through this approach, the FINPAC Project implements an 'Early Warning, Early Action' programme of community engagement activities and pilot projects for climate change and disaster resiliency across eight communities in the Pacific. Feedback during community engagement serves to ensure the training and activities are targeted to strengthen community resilience through improved early warning capacity of all villagers.

From the onset, it is crucial to ensure that the consultation process takes into account community customs, availability of stakeholders, and the capacity and gender context of local actors, including those who are physically, socially, and economically isolated. In a project of this nature, it is necessary that a culturally appropriate and mutually respectful learning environment is created in which knowledge can be exchanged.

Keeping these needs in mind, the FINPAC project adopts the following four-stage process.

Stage 1: Selection of pilot communities and creation of working groups as beneficiaries

A National Coordination Team (NCT) is set up in each country to provide advice to project site selection, planning, and implementation, among other operational responsibilities. Site selection was based on criteria established by the NCT and the regional team (SPREP and IFRC). The target sites included those considered most vulnerable, isolated, recently affected by a disaster, and without much outside support. The NCT typically consists of key staff of NDMO, NMHS, National Red Cross Societies, civil society organisations (within the community and from the national level), community champions/leaders, and sectoral experts (as needed, such as water, drought, or infrastructure experts). A National Facilitation Team (NFT) is the key contact point with the community and responsible for conducting community consultation and implementation of pilot activities.

After consultations between the NCT and village focal point, a vulnerable community is selected to host the workshop. For example, in the Cook Islands, the community of Tautu on the remote island atoll of Aitutaki was selected because of its specific vulnerability to category 4 cyclones. A Regional Facilitation Team is set up to support the NCT, typically consisting of representatives from IFRC, SPREP, and the Red Cross Red Crescent Climate Centre.

Stage 2: Baseline survey

Once a community is selected, a baseline survey is conducted to ascertain:

- the level of understanding of current weather and climate information provided by the NMHS;
- specific needs, and how the NMHS could meet those needs;
- modes of communication that the communities use to access climate and weather information; and
- how much communities use traditional and 'modern' sources of climate and weather information to plan daily livelihood activities.

Stage 3: Training, community consultation, and development of action plan

First, the NFT is trained in participatory community consultation techniques and community-based early warning system (CBEWS) definitions, components, and principles. As part of this training, key terms are translated into the local language.

Second, the NCT uses the outputs of the baseline survey to develop a workshop structure, specific to the needs of the community. These workshops are based on the Red Cross Vulnerability and Capacity Assessment (VCA) process and typically follow a five-phase process through an 'Early Warning, Early Action' lens:

- identify hazards faced by the community and their capacity to manage hazard impacts, vulnerabilities, and capacities;
- assess early warning strengths, gaps, and needs;
- assess weather and climate information provided by NMHS;
- identify priority weather and climate information needs, including suitable delivery mechanisms and educational materials;
- develop a community climate and disaster resilience plan (CCDRP);
- seek formal endorsement of the action plan from community leaders, NCT, and other key stakeholders as appropriate; and
- consult, identify, and cost a priority action from the CCDRP to be implemented by the FINPAC project.

Early warning systems (EWS) were prioritised by most pilot communities.

Stage 4: Implementation of small pilot projects with seed funding from the FINPAC Project

Through consultation with NCT, pilot communities and partners plan for implementation, and project execution is carried out and funded by FINPAC. The community with the assistance of national and regional partners also works together to seek other donor funding for implementing other priorities in the plan. For example, in the case of Mounga'one, Tonga, the Tonga National Meteorological Services secured additional support from UNESCO to strengthen Mounga'one's early warning systems. Cook Islands Red Cross secured funding from the Government to carry out a second community workshop on meteorological information and support a roof tie-down exercise for 40 households. New Zealand Red Cross is supporting the involvement of Solomon Islands Red Cross in the management of a community project in Lord Howe.

Stage 5: Simulation and lessons learned

A simulation exercise is conducted to demonstrate the effectiveness of the CBEWS. The outcomes of the simulation are discussed, and the CBEWS is modified accordingly. A country report is produced at the completion of the in-country workshops, trainings, and simulation exercise to capture outputs. A midterm review and annual reporting further capture outputs and lessons learned. A practitioner's workshop bringing together key stakeholders from each country will be held to capture lessons learned at the regional level to community level.

Management

FINPAC is funded by the Government of Finland through SPREP until December 2016. The New Zealand Red Cross and the Canadian Government also provided some funding to implement the CBEWS projects. SPREP and its Pacific Meteorological Desk Partnership in collaboration with the IFRC, NMHS, and the NDMO acts as the main technical advisors and supervisory mechanisms while implementation is carried out on the ground by the NCT and the pilot community. NMHS and NDMO are the two key partners at the national level. The IFRC and National Red Cross Societies facilitate community engagement and early warning systems pilot projects with the NMHS and NDMO.

Outcomes

One of the notable outcomes of the FINPAC project Component Two is its facilitation and enabling role that brought together stakeholders to address the weather and climate change needs of communities. The FINPAC project established models for partnership arrangements between civil society, government, and communities for the delivery of climate services.

Key outputs and outcomes included the development of effective CBEWS as part of community climate and disaster resilience plans. For example, in Samoa, following the consultation workshop, a community weather and climate information board was installed as part of the early warning system plan. Furthermore, village Emergency Response Teams were provided with transistor radios to receive weather and warning updates. In the Cook Islands, a siren was installed in the cyclone-prone village of Tautu, and disaster drills and roof tie-down exercises for households were conducted to test community response. The community of Jenrok, Marshall Islands, opted for a low cost, low tech community early warning system through building bell houses with used gas cylinder bottles as the alarm for alerts and warnings. Vanuatu engaged and trained the youths of Epau to build traditional houses based on their recent experience that the structural design proved to withstand Tropical Cyclone Pam Category 5 wind speed. The remote islets of Ribono and Nuotaea in Abaiang, Kiribati, equipped the traditional communicator “Wiin Te Kaawa” and the island councillor with a bicycle and a loudhailer to reach each household with early warning information.

Understanding the risks is critical in the FINPAC Community Early Warning Systems. Photo: Vanuatu Red Cross and IFRC

There has already been an increasing effect nationally and regionally as result of the workshops: community contributions are beginning to inform national level products and services and improve communication and outreach of NMHS with communities. In Vanuatu, the national cyclone tracking map was updated and tailored to community-level needs based on feedback provided as part of FINPAC Vanuatu. During the FINPAC workshop in Epau, the community gave direct feedback to the Vanuatu NMHS on difficulties faced in reading and using the tracking map. The Vanuatu NMHS then simplified and updated the map through an interactive consultation process with the community (and others) before finalising and launching nationally.

In Tonga, the FINPAC project component targeted at building resilience in communities established community rainfall harvesting support. As part of a World Bank Group-funded cyclone response plan that was adopted by the community, cyclone-resilient houses were built, with each group of 25 having access to a 5,000-litre water tank for their household use. Through its consultation process, the FINPAC project identified the need for monitoring the rainfall patterns in the area alongside water use. With the assistance of the NMHS to provide the required rainfall predictions, the community developed a colour-coding scheme to identify tanks at various levels of fullness to ensure that the community were well informed and well prepared for dry conditions. They also installed an information board which would monitor the amount of rainfall and water catchment.

Input from the communities about the gaps and lack of understanding of 'all things meteorological' has helped develop required outcomes from the communications training with NMHS staff and their national media organisations, which are also implemented under the FINPAC project. It should be noted that this training should be ongoing. The process of building awareness of the crucial role of effective communication of meteorological information has begun, and this support needs to continue on a more regular basis.

The project as a whole is still being implemented, and therefore, full outcomes will be available around mid-2017. An end-point practitioners' workshop is planned for October 2016.

Lessons Learnt

The following key methods and practices were identified as key components to the success of the project.

Workshop Structure

Sequential timing between the country workshops allowed for lessons learnt from previous workshops to be incorporated into the next workshop (e.g. strengthening the engagement with community leaders prior to the baseline survey).

The regional focus of the project has generated a platform for the development of shared resources between countries, such as guides for facilitators and participants.

General Procedure

Merging the Red Cross' participatory community engagement techniques with the technical expertise from SPREP, NMHS and NDMO has been integral in bridging a large component of the existing information, knowledge, and communication gaps.

Conducting 'one-to-one' dialogues between members of pilot communities and the NMHS staff is an effective way to foster mutually respectful and detailed two-way exchanges and therefore greater understanding of information needs.

A flexible workshop design allows for the recognition of country and community needs and priorities and integration with existing initiatives, so as not to duplicate or waste resources.

Overall Lessons Learnt

As is appropriate for the Pacific, trust is developed through spending time together in 'talanoa' (talking and sharing stories and ideas) with mutual respect. This time also creates a space for sharing (two ways)

of technical information about weather and climate information and traditional knowledge and creates the opportunity for establishing ongoing relationships for continued communication and collaboration.

It is beneficial if the community workshops are held prior to and separately from the media component of the FINPAC. When held before, we are able to effectively use the feedback from the community engagement to provide 'real case' scenarios and feedback and to address the gaps identified by the community.

While it is ideal to hold the media component separately from the community engagement to avoid overburdening of communities, the costs of doing business in remote communities and synchronising the availability of partners and of communities need to be considered carefully and factored into the project cost and timelines.

One of the underlying challenges related to the project is the large amount of time, resources and effort needed for coordination. However, the multi-country, multi-partner, and multi-scale approach has proven to be immensely valuable, making the effort worthwhile. These costs need to be factored into the project document.

Logistical challenges also occurred, such as finding a time suitable for all project stakeholders including pilot communities to hold an event according to the timeline of the project and ensuring that workshops involved a fair representation of the various members of the community.

Expressing technical material and scientific concepts in ways easily understood by the community can be a daunting task. NMHS staff are indispensable partners because they can speak the local language. The use of climate games and other participatory techniques to communicate complex technical concepts also helps, as does the establishment of a dedicated NFT and structuring the entire process to include a dedicated training phase for the NFT.

Future

This project has already developed a number of priority early warning systems in pilot communities. The present funding by the Government of Finland will cease in December 2016. The FINPAC project is seeking alternative funding sources to ensure its full completion within the Pacific region, given its positive impact already demonstrated. Additional funding made available through IFRC is enabling the FINPAC project model to be rolled out in additional projects in Fiji, Tuvalu, Kiribati, Republic of the Marshall Islands, Palau, and Federated States of Micronesia.

Youth Focus Group discussion on Community Early Warning Systems for Lord Howe Community, Honiara. Photo: Christina Leala-Gale, SPREP

SECTION 3

Data Management

Tile Tofaeono, Samoa Meteorological Division

Rainfall data bank for short-term and long-term climate prediction

Author organisation	PNG National Weather Service
Contact person's name	Kila Kila
Contact person's email	Kila.kila31@gmail.com
Providers of service	PNG National Weather Service
Project timeframe	1875 and ongoing
Location	On strategic provinces of PNG
Funding mechanism(s)	Government of PNG and Bureau of Meteorology

Summary

The Papua New Guinea National Weather Service (PNG NWS) has long-established historical weather and climate datasets, regularly updated up to the current day. It has improved its services from an aviation-oriented organisation to become an organisation that produces forecasts and climate services that are used in planning, decision-making, and management for specific locations.

The PNG NWS aims to further improve its role in providing quality, reliable weather forecasts and climate services to the public and all stakeholders. This will only be effective if the observation station network is extended to include district levels because Papua New Guinea is a large country compared to other Pacific island countries.

Background

The PNG NWS was established after independence in 1975. Before that, it was a territory under the Bureau of Meteorology, Australia, collecting data and providing weather information to the aviation industry. The PNG NWS expanded its services to forecasting and to climate information when the Climate Division was established in 1992.

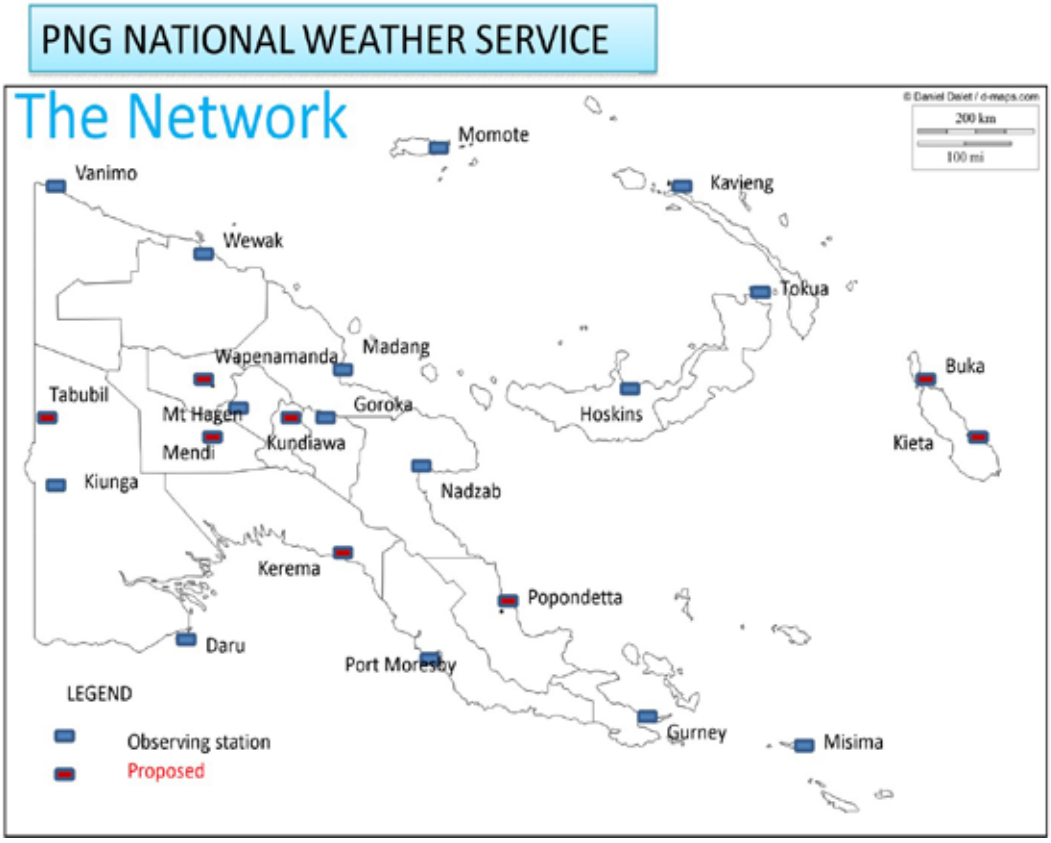
Currently, there are 12 stations that collect climate data across the country (see map on following page). There are also 22 rainfall stations in the country (not indicated on the map) that collect only rainfall data and these stations contribute to our rainfall data bank. In addition, there are five automatic weather stations.

Furthermore, the PNG NWS, in collaboration, receives rainfall data collected by organisations like the National Agriculture Research Institute, Coffee Industry, and Eda Ranu, the commercial water suppliers. With the data that these organisations send, PNG NWS are able to produce a climate outlook to assist in their management and planning. Their data is also digitised, archived, and used whenever the need arises. This collaboration between PNG NWS and other organisations has helped in the coverage of specific locations where PNG NWS do not have a weather station.

All the data that is collected is of vital importance, and PNG NWS has identified other areas to improve its mandatory service of providing reliable weather forecast and climate information, especially to:

- local communities in planning for their social activities;
- local farmers in planning for planting, harvesting, and fertilisation of their crops, e.g. in the coffee industry;

- small boat operators under the Small Craft Safety Act, including coastal vessels under Merchants Act (over 10 meters long) operating within the waters of PNG;
- the National Disaster Centre, enhancing its functional responsibilities through awareness and early warning on the onset of hydro-meteorological related hazards and emergencies;
- hydro-electricity energy suppliers to sustainably manage the supply of electricity to their consumers; and
- main commercial water suppliers like Eda Ranu to manage water supply sustainably to the residents of Port Moresby city and nearby local villages.



Map showing 12 climate data collection stations and proposed sites in Papua New Guinea. Source: Samuel Maiha, PNG National Weather Service

Methods

Site selection: Site selection is part of the data collection process. In a big country like PNG, selecting a site to collect rainfall data is a big challenge. Often, land issues or conflicts occur among communities when a data collection site is chosen. To be successful, officers carry out education and awareness on the importance and benefits of having a data collection station. In some cases, agreements are made with schools or guest-house owners to set up stations within their yard. In that way, the PNG NWS can maintain the security of the instruments. In return, a stipend is paid to the person(s) in charge.

Instrumentation: The PNG NWS team installs new instruments as well as replacing worn instruments at existing stations.

Data collection: Observers collect readings on a daily basis from observation stations in different parts of the country. At the end of the month, observed rainfall data and climate reports are sent to the headquarters in Port Moresby, Papua New Guinea via telephone, fax machine, or personal mobile phones. By the end of the month, observation books are sent to the Port Moresby station.

Data digitisation and archiving: Observation books are checked by the quality control officer before the data are entered into the database Climate Data for the Environment (CLiDE). On a daily basis, casual workers do key entry into the CLiDE database and Excel spreadsheet as backups. With the introduction of CLiDE, data are stored safely and can be extracted whenever users need it.

Stakeholders

The main stakeholders include:

- colonial stakeholders, who were responsible in setting up the stations and collection of data, e.g. Australian Government Officers. Much of the collected data have been stored in Melbourne and were lately released to the PNG NWS;
- regional partners through training and skills transfer, including the Climate and Oceans Support Program in the Pacific region (COSPPac);
- the Government of Papua New Guinea through its annual budget;
- designated locals and government officers at collection points of data; and
- users of information produced by PNG NWS, e.g. Provincial Governments and the National Disaster Centre.

Management

Initially, the data collection was supported by the colonial government, and funding was consistent. Currently, the Government of Papua New Guinea funds the NWS through its annual budget. Donor agencies, including European Union, AUSAID, World Bank, etc., also provide vital support.

- Some donor-funded projects for the PNG NWS and in alignment with the PNG Government Development policies are managed by the donors. The installation work is done by PNG NWS officers.
- Officers in charge at each observation station report on maintenance needs of data collection instruments.
- Landowner and community engagement plays an important role in the management of the project. When locals are engaged, they take responsibility to care for the instruments.

Raw data are managed by digitisation into the database and Excel spreadsheets. Copies are then made in hard drives as backups. Finally, observation books are sent to the national archives for archiving.

Discussion with a village councillor and his Project Committee on how they can better use Climate Outlooks for water resource management and agricultural development. Photo: Kenan Bala

Resources

Human resources are the key resource to any form of project. Thus, we have trained staff for instrument installation and maintenance, data collection and archiving.

Better communication systems are needed for data transfer from other observation stations to Port Moresby.

Financial capacity, i.e. sufficient budget for instruments and maintenance, is vital to programme sustainability.

Outcomes

There are many benefits to the establishment of the rainfall stations across PNG.

The PNG NWS has improved its capacity for forecasting from generalised locations narrowed down from region-specific (for example, from region to province scale, from daily forecast to weekly and monthly climate outlook to 3 months time scale).

An example product is the seasonal climate outlook that is produced and given to all our stakeholders.

There is strong stakeholder engagement. For example, the Disaster Risk Reduction committee uses the climate forecasts for disaster risk preparedness.

Data are used for research purposes. Researchers, including those from universities, visit the PNG NWS office to collect information.

Lessons Learnt

'Data collected should not only be stored but also given to end users upon request in the form of raw data or reports.

Working in partnership with stakeholders, NGOs, donor agencies, and international partners enhances capacity building.

The role of PNG NWS is not limited to data collection but also producing information products that can be used for planning and management.

Making the ownership of collection of rainfall data and care for the instruments the responsibilities of provincial authorities and communities is effective for long-term operations.

Provision of funding by the Government of PNG would increase the long-term sustainability of the operations.

Commercial consumers like mining companies can provide important support if they agree to chip in through funding for the installations of instruments and collection of raw data.

Challenges

Working with local people in trying to set up a new station can be challenging. Trying to secure a possible site creates delays that are eventually addressed through negotiations where local communities or landowners receive a stipend.

Maintenance of the instruments remains another challenge. This is addressed by allocations of funds from the government of Papua New Guinea through its annual budget and working with partners to sustain maintenance.

Communication between the meteorology offices in the provinces can be a challenge. This challenge has been addressed by the use of cell phones. Officers in the outer stations usually use their personal mobile phones to call the headquarters to provide rainfall data that are needed immediately.

Future

The PNG NWS will install climate stations at the proposed sites and increase the number of automatic weather stations.

The continuous support of donor agencies like European Union and regional support like Australian Bureau, is vital for financial and training support.

PNG NWS wishes to continue its services by expanding to the proposed sites and improving communication systems of the automatic weather stations.

PNG NWS also plans to further improve on the sector-specific products, such as a product that can be used by the PNG Red Cross.

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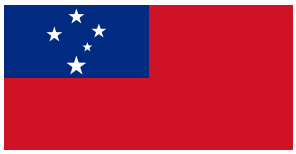
Observer collecting data. Photo: Ms. Kila Kila, PNG National Weather Service

Climate data digitisation



Author organisation	Samoa Meteorology Division
Contact person's name	Tile Tofaeono
Contact person's email	tile.tofaeono@mnre.gov.ws
Providers of the service (including partners)	Samoa Meteorology Division, Bureau of Meteorology (BoM)
Project timeframe	2012–2013
Location	Apia, Samoa
Primary target audience	Samoa Meteorological Division, Samoa Climate Stakeholders and Partners
Funding mechanism(s)	Pacific Australia Climate Change Science Adaptation Planning Program (PACCSAP) – BoM and Government of Samoa

Summary

Information about Samoa's weather and climate has been recorded for more than 100 years, written on papers that now make high stacks of unique and important historical records, but which are very fragile due to the way it is kept. The tropical weather so carefully written down is attacking the paper itself, and the use of the papers will not last as long as the usefulness of the information. Today's meteorologists work on computers, and the old data—still valuable—need to be brought back to life for use in modern analyses.

Data digitisation ensures the rescue of historic climate data and expands the length of climate data series that are available for climate trend analysis and climate research. These long, unique data series will build greater understanding of Samoa's climate and the factors affecting it.

Background

Samoa Meteorology Division was established in 1890 as a weather observing station and began recording traditional weather parameters such as wind direction, wind speed, rainfall and temperature in 1905. The Samoa Meteorological data vault currently holds more than 100 years of data recorded in field books. The data is important to the Samoa Meteorology Division, construction companies, water sector, students, and researchers, but the old forms of record keeping are not stable or easy to use, particularly in a tropical environment.

Historical records in the Samoa Met Office vault before the digitasion process. Photo:Tile Tofaeono, Samoa Meteorological Service

Methods and Management

The Samoa Meteorology Division secured funding for data digitisation from the Pacific-Australia Climate Change Science and Application Planning (PACCSAP) project under the BoM. The funds were used to hire and equip five Climate Data Entry Operators (CDEO) and train them over a period of two weeks of full-time management by a Senior Officer.

One week of the training was spent on understanding the data format and theory regarding the data. The other week was spent on practical work on the Climate Data for the Environment (CliDE) database, which houses both new and historical data before they start with data digitisation.

Resources

- Human Resources
- Five data entry operators, spending 40 hours/week for 12 months full-time
- One Senior officer to supervise the project
- IT Resources
- Five desktop computers with power supplies
- Storage device
- One laser printer for data analysis

Outcomes

During the digitisation process, the following outcomes from the initial proposal have been achieved.

- 100% of daily records for eight of our climate stations (rainfall, maximum temperature, minimum temperature, wind direction and speed, cloud cover, humidity, and evaporation) were digitised.
- 95% of sub-daily records for 8 climate stations were digitised.
- Increase in number of years available for climate change research for Samoa.
- Allowed sector-specific output products to be tailor made to address sector needs.
- Improvement to Geographic Information System capability and its use to improve climate products for end users.
- Extended the range of years of climate data that can be used for different analytical purposes hence increasing the opportunities for higher revenues to support the services provided. In addition, there has been an increase in the request for technical input using digitised rainfall data for litigation purposes.

In addition to these planned outcomes the following were additional outcomes achieved through the project:

- Created work experience for young university students looking for work experience in the meteorology field.
- Increased research opportunities and applications for research purposes by students

Lessons Learnt

Short-term contracts for CDEOs means these staff will move on to other employment opportunities if their positions are not mainstreamed into the SMD structure after their contracts. All five CDEOs were hired at the same time when the project started. When the project finished, we managed to secure funds under COSPPac to extend two CDEOs based on their performance for another 12 months.

Two CDEO positions have been mainstreamed into the office structure to help with quality assurance of current data.

There is limited funding to continue digitising new data, specifically with the entry of data from manual stations.

After seeing the success of this project, the Samoa Meteorology Division allocated funding to mainstream 2 new positions to continue this work.

The data digitisation has been very beneficial to the Meteorology Division, allowing for better analysis in our work due to a more robust data set and providing satisfaction to our clients.

Future

All of the information collected by the Meteorology Division needs to be digital. Continued support is needed to mainstream the positions of Climate Data Entry Operators into the division structure. In addition, the Samoa Meteorology Division should look up missing data from other data centres to fill the gaps in the Samoan database. The new staff positions created based on the success of this project will help the Samoa Meteorology Division meet its future needs and keep Samoa's meteorological data safe and functional.

Climate Data Entry Operators at work. Photo:Tile Tofaeono, Samoa Meteorological Service

Community-based rainfall network monitoring

Author organisation	Vanuatu Meteorology and Geo-Hazards
Contact person's name	Philip Malsale
Contact person's email	malsale@meteo.gov.vu
Providers of the service (including partners)	Vanuatu Meteorology and Geo-Hazards Department
Project timeframe	On-going
Location	84 sites in Vanuatu
Primary target audience	Communities
Funding mechanism(s)	Vanuatu and Australian Governments

Summary

Tropical Pacific climate data are particularly important to our understanding of the global climate system. Research projects dealing with climate variability and change require sufficient and accurate data to reach useful conclusions; however, available data of this quality are currently limited. Thus, robust networks to collect climate information, including rainfall observations, in the Pacific region are essential for supporting research on climate variability, climate change, and adaptation.

Background

The establishment of the Vanuatu Rainfall Network (VRN) is a classic example of the government of Vanuatu working together with communities to improve rainfall observations and climate services throughout Vanuatu since 2005. Prior to the establishment of this rainfall network, the Vanuatu Meteorology and Geo-Hazards Department (VMGD) used rainfall data from seven synoptic sites to provide a statistical rainfall forecast for seven areas. These areas are Sola, Pekoa, Lamap, Port Vila, Bauerfield, White, and Analguhat on 6 islands.

VMGD's statistical rainfall forecast is an important decision-making tool now used by farmers throughout Vanuatu. It helps farmers decide where, when, and what to plant based on anticipated seasonal rainfall in the months ahead. As farmers learned to understand specific rainfall forecast information for each island, the demand and need for this kind of information from farmers in other islands grew. VMGD had identified the need to expand the rainfall observation network to other islands in order for the Seasonal Climate Outlook for Pacific Island Countries (SCOPIC) project to provide specific seasonal rainfall forecasts for specific provinces and those islands.

As a result, VMGD revived the rainfall collection network set up by the Schools of the Pacific Rainfall Climate Experiment (SPARCE) programme to help meet this demand. VMGD established the VRN in 2005 with 8 stations, starting in the south of the country. As of 2015, the network now consists of 84 rainfall sites monitored by rainfall collectors throughout the country. The rainfall collectors are community members.

While VRN was established to collect, analyse, verify, and disseminate Vanuatu's rainfall data and products to aid decision making and to contribute to climate adaptation and mitigation at the community level, the network also allows the VMGD to build and sustain the global climate observing system needed to satisfy the long-term climate observational requirements of operational climate forecast centres, international research programs, and major scientific assessments.

The VRN is run, maintained, and owned by individuals in the communities with the support of the government, on a relatively low budget, through effective collaboration with projects implemented in the Pacific region. VMGD is able to run this network at the cost-effective rate of only one US dollar per day.

Methods

With initial funding from the National Oceanic and Atmospheric Administration (NOAA) Schools of the Pacific Rainfall Climate Experiment (SPARCE) programme of the United States of America, the climate division started by installing 8 manual rain gauges in the southern part of the country on the island of Tanna, Tafea province. With the growing interest and potential for these sites to develop, the Vanuatu and Australia governments provided financial assistance to expand the activity to the central and northern parts of Vanuatu. Although it started with donor funding, the initiative is now successfully operated and maintained by the Vanuatu government.

Significant institutional strengthening was required to make this happen. Within the VMGD, there was a review of structure, and a post was created to look after this activity. On an annual basis, officers from required divisions (Observation, Engineering, and Climate) are deployed to outer islands to install and maintain rain gauges. The tasks required for this activity to happen include the following:

Selection of rainfall sites: The manual developed has World Meteorological Organization observation site-selection standards to determine the sites selected for rain gauges. Although the site selection is discussed with the forecasting division of VMGD, because sustainability is prioritised, the final decision lies with the climate division.

Selection of rainfall volunteers: Selection is based on family unit instead of a community. The rain gauges are installed within a private or public yard (church, schools, dispensary, or other public premises) but are looked after by an individual. The key criterion for the selection of a rainfall collector is sustainability. VMGD needs a person who is eager to carry out this activity and willing to learn. It has been more effective to select somebody who has a closer link with a climate officer or someone within VMGD so follow up will be easy, especially to chase missing data or confront that person if he/she is not performing.

Installation of rain gauges: The team must have the necessary tools and materials, such as hammer, nails, screws, screw drivers, level, spade, and cement. In cases where there are not tools available, the team can borrow from the community. The team needs to have some cash in hand to spend on materials.

Signing of contracts: A contract is signed between VMGD and the person selected, outlining the responsibilities for the rainfall collector and the incentive he/she will get. The payment will be made two times in a year (July and December), deposited directly into their bank accounts. Rainfall collectors are required to establish a bank account, if they do not already have one.

Capacity building: Training rainfall collectors to observe weather is the key to the success of this activity. Every rainfall collector receives one-on-one training during the rain gauge installation. A WMO observation standard workshop covering maintenance of the rain gauge, the use of SMS, and the importance of data collection and its linkages to climate is sufficient to carry out this job. In addition, on-going national training of all rainfall collectors is done every two to four years, depending on funding availability.

Establishment toolkit: Upon induction, rainfall collectors are provided with a toolkit, consisting of a logbook, monthly form, envelopes and stamps, tropical cyclone-tracking maps, and contact details of officers at VMGD that will remain with the rainfall collector.

Telephone/mobile phones: All rainfall collectors must have mobile phones to call and receive messages. The VMGD officer calls every rainfall collector monthly to collect the past month's rainfall observations for each site.

Stakeholders

The stakeholders that are required to implement the VRN are:

- **VMGD**: which through the Observation division oversees the rainfall observations and needs to be consulted to meet World Meteorological Organization rainfall observation standards;
- **the finance department:** Any contract must gain approval from the finance division, which will liaise with the finance department if funding is available either through government recurrent budgets or donors for this activity. The approval will come via a financial visa (a letter);

- **the provincial government:** VMGD require an approval letter from provincial government prior to installing a rain gauge on site;
- **communities**: The community or family will need to be consulted and agree to host the rain gauge. There will be a form of agreement for them to host the rain gauge in their yard or land for free; and
- **families**: It is preferred to choose a rainfall collector who is related to an officer in VMGD to allow close monitoring of performance. The person will sign a contract for the roles in looking after the rain gauge and carrying out rainfall observation. In the past, before family members were employed, rainfall gauge monitoring was not done consistently. Engagement with community, schools, or churches failed.

Management

The project was initially funded by NOAA and the Vanuatu government. Later, the Australian and Vanuatu governments continued with the implementation. Now, it is only the Vanuatu government through the VMGD that is maintaining and making VRN operational. The climate division is responsible for planning and budgeting, and VRN is a core activity within the division.

An officer is dedicated to overseeing the running and implementation of the VRN. The rainfall collectors report directly to this officer and also work closely with the VMGD officers in the provinces. Communication is done by tele-radio, mobile phone, and SMS, and whenever the rainfall collector comes to town, the collectors are called to VMGD for updates and to list any other resources needed for the site.

The rainfall data collected from these rainfall sites are archived in the CliDE database. The hard copies are also archived. The rainfall data are provided to users upon request. The data are slowly building up as the project reaches its fifth year of operation. Once this reaches 30 years, Vanuatu will have a good rainfall dataset that can be of great benefit to the country.

The financing component of the project is a decision made between the officer overseeing the VRN who assesses the performance of rainfall collectors, the manager of climate division who verifies and agrees about payments, and the finance sector of VMGD, which produces payment of incentives and other procurements for this activity.

The project is evaluated through:

- monthly rainfall data collection: The incentive payments are made according to the percentage of rainfall data collected. If rainfall data for the first six months is 70%, then rainfall collection will receive 70% of the total payment;
- the number of calls from the rainfall collectors to know about weather-related issues; and
- quarterly and annual reports produced by the officer responsible for the VRN based upon the information above.

Resources

The resources needed to set up the VRN are:

- finances, both internal or external, to fund rain gauges and trips to the islands for site survey and installation;
- institutional strengthening, including a restructuring of the climate division to include a post with a job description that cater to the responsibilities of the rainfall observer;
- human resources, specifically more observers, climatologists, and forecasters to carry out trainings;
- an establishment toolkit, consisting of a logbook, monthly form, envelopes and stamps, tropical cyclone-tracking maps, and contact details of officers at VMGD;
- a database that stores soft and hard copies of the rainfall data;

- reporting at the end of each quarter;
- reviews of work procedures and responsibilities, ensuring that these are addressed in the job description;
- funds to replace old rain gauges; and
- funds to pay rainfall collectors.

The funds to replace old rain gauges and to pay the data collectors have been the greatest resource challenges.

Outcomes

The initial objective of the VRN was to set up rain gauges throughout islands in Vanuatu to expand the rainfall observation network to help with rainfall seasonal forecasting. VRN has continued to grow, with more responsibilities added to the rainfall volunteers. The VRN has had numerous spill-over benefits for Vanuatu and the scientific community through:

- **observing rainfall, cloud cover, wind speed and wind direction**: This information is recorded in the Climate Data for the Environment (CliDE) database and can be made available to support scientific research and adaptation planning through seasonal rainfall outlooks;
- **monitoring weather and climate traditional knowledge indicators:** This monitoring enables linkages between science and local knowledge and will test the reliability of traditional indicators in a changing climate;
- **enabling beneficial two-way communication:** Rainfall collectors provide focal points for the Vanuatu government for sourcing climate and weather information for the communities; they can also assist with processes such as observation validation. For example, the rainfall data collected in the area confirmed the amount of rainfall received to trigger the Ambrym landslide;
- **supporting disaster risk reduction and climate change adaptation:** Rainfall collectors are part of community disaster committees and have a role in promoting action on climate adaptation and mitigation. For example, rainfall data collected are used for project design and were part of the information about tropical cyclone Pam disseminated at the community level;
- **building partnerships at the community, provincial, and national level:** The work of agencies such as the National Red Cross and National Disaster Management Offices is strengthened and supported on the ground by provincially based VRN members;
- **supporting farmers:** Farmers are more aware of the linkages between weather, climate, and agricultural productivity. They learn the importance of using VMGD information for decision making; and
- **increasing knowledge:** Overall, the VRN help builds knowledge of farmers, students, and other community members on weather and climate.

Rainfall volunteers in joint planning with Red Cross volunteers, provincial area secretaries during the provincial workshop on educating and using climate information for decision making at the provincial, area secretary and community level. Photo: Philip Malsale, Vanuatu Meteorology and Geo-Hazards Department

Lessons Learnt

Partnership between the national government and communities is key for a successful VRN. This approach has demonstrated a shift in government attitude. Previously, only provincial government officers were engaged to carry out such scientific activities, but now people in the communities themselves see, feel, and practice the process of data collection. Collecting rainfall data impresses upon them that data are important in the science world and helps to better inform people about the issues of climate variability and change. This is community science at its best in Vanuatu.

Taking science practices to the community enables people to better understand the role of the VMGD and helps them to fully participate to expand the rainfall network in Vanuatu. This involves getting the rainfall collectors to carry out observations in the communities where no high-tech instruments are installed, to support and appreciate the work of the meteorological services.

Setting up a network like the VRN has empowered rural data collectors to be the mouthpiece of VMGD in their communities. They disseminate the information relating to tropical cyclone and ENSO events to their communities. These collectors play an important role in disaster risk reduction and climate change adaptation activities in those communities where they are part of the community disaster committees. Empowering local communities is the way to address the challenges of disaster risk reduction and climate change adaptation.

We continue to experience some challenges.

Maintenance of rain gauges is vital. The high level of humidity in Vanuatu reduces the lifespan of plastic rain gauges and erodes the timber to which the rain gauge is moulded. This issue is addressed by using metal gauges that are installed into the earth and are more resistant to humid weather. During training, rainfall collectors learn how to maintain rain gauges. VMGD is now starting to provide security fences for the sites to protect from animals and people.

Missing data and errors in rainfall data are problematic. Getting the rain gauge to the rural community is a challenge, and sometimes with the low literacy level in the community, there are errors in rainfall data. VMGD address this through continuous training for rainfall volunteers. Also, there are some areas where automated rain gauges are installed close to the manual gauge so data can be transmitted directly to the data centre and can be archived automatically. During times when monthly rainfall does not reach VMGD, the rainfall collectors provide missing data using a logbook of recorded rainfall data that is archived at the rainfall site. The rainfall data are also texted on a daily basis and cross-checked at the end of each month to minimise data errors.

Sometimes rainfall collectors are not performing to the standard required to maintain a 100% record of data each month. There are cases where the rainfall collector had to travel to another area for other commitments, so rainfall data are not recorded, therefore contributing to the missing data in the database. One step taken to address this is to have refresher training every two years, but this training requires a lot of funding because it involves 84 people who are scattered all over Vanuatu. VMGD also address this issue by taking opportunity to train at least two members of the family on rainfall reading and weather observation when opportunity arises. Moreover, payments are deducted depending on performance of each collector.

Future

Future of the VRN

To make the VRN scientifically useful, VMGD is incorporating these activities into its annual business plan to maintain this network for 30 years. It takes a lot of commitment financially, but this is for the best interest of Vanuatu in a changing climate. The future of this network is bright, with plans for the rainfall sites to be automated and be part of the Vanuatu Early warning system for weather and climate. There are some proposed upcoming projects that aim to automate at least 50% of rain gauges so data can be transmitted to the data centre in real time. The projects will build around Climate Early Warning Systems so rainfall data can be used for this purpose and others to meet sector-specific needs. In the longer term, these rainfall volunteers will observe more than one variable and will be part of the official VMGD structure.

VRN Facts

- 35 islands
- 84 communities involved
- 84 rainfall collectors trained, 16% are women
- 84 rainfall gauge equipment installed with guides published and distributed
- Rainfall volunteers are VMDG focal points in the community
- Rainfall volunteers who have very limited access to mobile networks have to walk long distances or climb trees to provide data through phones
- VRN benefits climate science and adaptation planning by
  - observing rainfall, cloud cover, wind speed, and wind direction;
  - monitoring weather and climate traditional knowledge indicators;
  - enabling beneficial two-way communication;
  - supporting disaster risk reduction and climate change adaptation; and
  - building partnerships at the community, provincial, and national level.

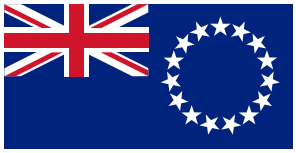
Vanuatu National workshop on enhancing rainfall network in Luganville, Santo, 2013. Photo: Philip Malsale, Vanuatu Meteorology and Geo-Hazards Department

SECTION 4

Disaster and Health

Sunny Seuseu, SPREP

Monitoring and communicating drought in the southern Cook Islands



Author organisation	Cook Islands Meteorological Service
Contact person's name	Mr Arona Ngari
Contact person's email	arona.ngari@cookislands.gov.ck
Providers of the service (including partners)	CIMS; SPREP; BoM; WMO
Project timeframe	2013–2014
Location	Cook Islands/Nga Pu Toru/Atiu
Primary target audience	Cook Islands communities on small atolls
Funding mechanism(s)	New Zealand High Commission

Summary

In 2014, a mild El Niño across the Pacific resulted in a critical water shortage for the Southern Cook Islands. The Seasonal Outlook forecast issued by the Cook Islands Meteorological Services (CIMS) clearly identified this drought episode in the outlook assisted by NIWA (National Institute for Water and Atmospheric Research) and BoM (Bureau of Meteorology). A request came from the Nga Pu Toru for water for the communities. The New Zealand High Commission Office in the Cook Islands responded, especially to Atiu in the Southern Cook Islands. Prior to El Niño, Atiu had already faced drought in the previous six months and was critically running short of water in the last two months. As a response, the High Commission office provided water treatment units with solar panels to help source and secure water for the island. The Office of the Prime Minister assisted the project with the supply of water tanks for all occupied households on the island. Similar processes were extended to other affected islands in the Southern Cook Islands.

Background

Three small atoll islands make up Te Nga-Pu-Toru, "The Three Roots", in the southern group of the Cook Islands. Twelve hours by boat or 45 minutes by plane from the main island of Rarotonga to the southwest, these communities are vulnerable to fresh water shortages and at times experience poor access to potable water. Prone to the vagaries of disaster risks such as drought, most likely exacerbated by climate change, Te Nga-Pu-Toru communities of about 500 people rely on local ingenuity and resources from outside to survive. One third of the country's annual 2,000 mm rainfall typically occurs during the dry season, and the other two thirds fall during the wet season. This trend, however, breaks down during El Niño years. Recent droughts have severely stressed communities as well as the local flora and fauna. Climate change is predicted to bring more severe and frequent extreme weather events that will bring further stress to the community.

The Cook Islands Meteorological Service is the implementing agency for early warning systems. Using Seasonal Climate Outlooks in Pacific Island Countries (SCOPIC) software and training from the Australian Bureau of Meteorology, CIMS started providing Seasonal Climate Outlooks in 2005. These outlooks provide three- to six-monthly outlooks on temperature and rainfall to crucial sectors. These outlooks clearly identify the risks of drought or flooding for different parts of the Cook Islands.

In 2014, the Southern Cook Islands experienced a severe drought influenced by a mild El Niño. The effect was a dry period for the Southern Cook Islands but a wet period for the Northern Cook Islands.

CIMS noticed this drought in the mid-2013 when the seasonal outlook indicated an easterly movement of the South Pacific Convergence over summer, remaining there for at least 9 months. A combined effort across the Pacific by National Meteorological Services for a media release on this pattern was carried out. CIMS complemented this media release with a news article in the local newspapers, news article on the local television, and a talk on the local radio station.

A contact in Atiu voluntarily records climate data and has a private weather station that has operated for more than 20 years. These data allowed CIMS to verify what was happening in Cook Islands. CIMS also collected data from other islands and passed this information on to the NZ High Commission.

The Drought Response Strategy on the island of Atiu in the Nga Pu Toru is a capacity-building programme targeting local communities to adapt to the situation and to become resilient to future events. The strategy was developed through the Cook Islands Red Cross. The local meteorological service is tasked to provide rainfall data to stakeholders, indicating warning trends of drought or flooding.

The target communities can improve their capacity for hands-on initiatives and donate resources in handling impacts from natural hazards. The project is aimed to be extended to other communities in the Cook Islands if it is successful. This strategy was tested during the 2014 drought.

Harvesting water is important for all households in Atiu as well as across Cook Islands to minimise impacts from drought. Photo: Climate Change Cook Islands

Methods

Using the community to assist and with some basic training skills in project implementation and infrastructure design, the task was conducted as follows:

- CIMS tracked the rainfall and provided warnings to the Southern Cooks.
- The SCOPIC outlook and Clide were used to provide 3 monthly outlooks.
- Newspaper, radio, and email warnings were sent to government and people in the southern Cook Islands.
- Data was provided to government and donors so they can take proactive measures.
- The remainder of the response was conducted by other institutions with the support of the CIMS to determine the length of time before a change in conditions. This response included supplying water to communities and other behavioural responses such as water tank delivery and communication of water rationing plans. Both 20 litre bottles and cartons of 330 ml bottles of drinking water were delivered to households.
- A monitoring team consisting of island executives, government agencies, and community representatives was established to oversee the progress of the project and consider how can they continue into the future beyond the current crisis.
- An inventory and an evaluation was requested of each household of the status of the project and how they think the project went.

Stakeholders

People involved in the project can be chronologically identified as each came in to play their role in the project, as follows:

- **Remote communities**: people of Aitu, Mauke, Mitiaro, Mangaia, and Aitutaki, including traditional leaders and landowners;
- **Government**: Office of the Prime Minister (OPM); Outer Islands Division staff of the Southern Cook Islands; Emergency Management Cook Islands; Strengthening the Resilience of Island Communities to Climate Change (SRICC); Traditional Leaders; Crown Law;
- **Donors**: New Zealand High Commission Office; and
- **NGO**: Cook Islands Red Cross Society.

Management

The project was monitored by the division of Strengthening the Resilience of Island Communities (SRIC) in the Office of the Prime Minister. As a division that is monitoring the distribution of water tanks to other prone areas in the Cook Islands, this division had the mandate and the management tool to oversee this project. Decisions on Atiu were made by the mayor, with constant dialogue between these two institutions.

Consolidation of reports for the different projects had assisted in the monitoring of this project due to its close links with other sectors. The project was evaluated by the SRICC Team and the OPM team.

Considering the high risk of extreme events and the concern for a strengthening El Niño episodes, the success of this project will carry the momentum toward a better prepared Cook Islands for the upcoming Tropical Cyclone season, which would include more convective clouds that bring rain.

Resources

Many of the required resources were all in-country, with additional resources from the private sector obtained from NZ or Australia. Operational climate services were made available by the National Meteorological Service and some parallel projects that they are involved in (for example, the Schools of the Pacific Rainfall Climate Experiment (SPARCE) programme is a rainfall collection monitoring programme for schools that monitors El Niño).

Labour and water tanks were provided by the government.

Solar panels and water pumps were provided by the NZ High Commission.

There was no lack of resources. Labour and technical expertise were provided by the Island Council, compensated by the project. Climate data were provided by a collaboration between government agencies and private sectors for a convincing argument that a crisis was at hand.

Outcomes

One of the main outcomes of the project was that water pumps, water bottles, water tanks, and water bores were cleaned, and the communities supported the project and worked together. They achieved their objective of getting water for the communities on Atiu. The communities are ready to tackle another drought if one occurred in the future.

A drought response plan was developed in partnership with EMCI and SRICC of the Cook Islands Government as a result of this event.

Lessons Learnt

Collection of meteorological data over a period of time can be useful to build resilience to certain climate- and weather-related natural hazards, such as drought.

In the future, planning should be done to cater for all islands concerned at once.

To enable CIMS to provide support in the future, a seasonal outlook for monthly, quarterly and 6-monthly time scales is useful to continually monitor such situations.

When there is no rain for 3 months, an inventory of water catchments is made. Water tanks are salvaged and cleaned to prepare for future water use.

When the seasonal outlook indicates less rainfall, we ask people to start conserving water. Monitoring of water usage begins. In the case of emergency, the mayor is advised. There is usually a village campaign for the mayor to follow up.

Challenges

It can be difficult to convince people that there is a severe drought. People did not understand the El Niño connection. Activities undertaken by CIMS have improved this public understanding.

False warnings are sometimes given by others outside CIMS. Future outreach and interactions from CIMS need to create and maintain a high respectability of CIMS to gain status as the trusted source of information.

Future

A triggering mechanism should be put in place to put this plan into action when the need arises.

Financial and human resources are required for Red Cross personnel, Water Division personnel, and Water Management and Disaster Risk Management experts from the island.

Related projects/programs are planned for the future through Strengthening the Resilience of Island Communities (SRIC).

Resources are needed to monitor how communities maintain these facilities after the support and at normal times.

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Seasonal Outlook produced by CIMS

Cook Islands – Investing in a Sustainable Future – ADB Development Effectiveness Brief

Improved community water harvesting is vital for people in Atiu. Photo: Christina Leala-Gale, SPREP

Climate information and services strengthen decisions

Author organisation	FSM National Weather Service Office
Contact person's name	Wallace Jacob
Contact person's email	Wallace.jacob@noaa.gov
Providers of the service (including partners)	Pacific ENSO Application Climate (PEAC) Center, WSOs in Chuuk, Pohnpei and Yap;
Project timeframe	From 1998 onward
Location	Federated States of Micronesia
Primary target audience	Government agencies, sectors, communities
Funding mechanism(s)	Core funding

Summary

In the past, the people in the Federated States of Micronesia (FSM) relied heavily on traditional knowledge for weather and climate information. They rarely depended on information from their Weather Service Offices. Now, the Weather Service Offices in the FSM are providing essential meteorological information and services, like El Niño warnings, typhoon information, rainfall data, and more. These information and services are starting to be recognised and appreciated. In fact, these services are important in informing the decisions that the FSM government leaders make to address climate change and climate variability.

Background

FSM consists of 607 islands varying from high mountainous islands to low-lying coral atolls. Some of these low-lying islands are so far from the main islands that travel to and fro can take two days or more by boat. The four main islands have rivers and streams, while the low-lying islands depend on water catchments and wells. This means a lot of people across the FSM are dependent on rainwater, and any changes or disruptions in the climate can be life threatening. Responsible for providing information on weather and climate related data are three Weather Service Offices (WSO) situated on the islands of Pohnpei, Chuuk, and Yap.

During the 1997–1998 El Nino, the FSM population suffered significantly from poor water availability and quality. The drought impact could have been reduced by earlier and more extensive public awareness campaigns and action. For example, water conservation measures and disaster relief could have been implemented earlier, especially for the atolls. Other possible actions include planting less water-intensive or drought-tolerant crops and implementing health measures to reduce the incidence of hepatitis, gastrointestinal diseases, and cholera. Now, these lessons have been learned, and climate information and services are more appreciated by the communities. After the event, the Pacific ENSO Application Climate (PEAC) became the official source of climate information and services for the Disaster Management Offices of the FSM.

Methods

The main source of climate information for the FSM is the Pacific ENSO Application Climate (PEAC) Center, established in 1994. PEAC provides information on monthly rainfall reports and rainfall outlooks, tropical cyclones activity, sea level discussion, ENSO discussions, forecast discussions, and drought-monitoring updates in the FSM. Before the 1997–1998 El Nino, this service received little attention within the FSM government. Now, all the information is being requested and shared between government agencies, state and national. Because of a common source of information among the government agencies in regard to climate information and services, communication has greatly improved among government agencies with regard to disaster-related issues.

Stakeholders

Everyone in the FSM benefits from the information PEAC provides. There is a PEAC newsletter issued quarterly which is available for the public to read. Every month, climate focal points from around the region—Hawaii, Guam, RMI, FSM, and Palau—participate in a teleconference that explains and updates the PEAC newsletter. The Disaster Management Offices in the FSM benefit the most from this climate service. With this climate information, the Disaster officers can update with confidence the Governors on the current status of weather and climate phenomenon. If anything from PEAC needs further elaboration, representatives from the WSO are requested to provide additional information. When it comes to climate and weather related disasters, the government and the community benefit greatly from the services and information PEAC provides.

Challenges

Challenges occur when complex scientific language is used. Representatives from the WSOs are required to brief government officials and give presentations and workshops to provide the stakeholders with a better understanding of the information being disseminated.

Language is also a challenge when sharing information with the Kahlaps (elderly). Some terms need to be translated into the various local languages of each island to be well understood.

The low-lying islands of the FSM are extensive, but not all these islands have meteorological observations. To address this problem, data from nearby islands are used.

Understanding climate information was a challenge in the beginning, but with better understanding of meteorological information, more people across the country now trust information from the WSO and PEAC.

School visits to the NWS is an opportunity to raise awareness amongst future leaders. Photo: Wallace Jacob,National Weather Service Office, FSM

Outcomes and Lessons Learnt

The government is increasingly involving the WSO in disaster management activities. The Pohnpei WSO is now part of the “Country Climate Team”, which deals with climate change adaptation and disaster risk management. More and more climate information is being requested, and demand for community outreach is becoming more frequent. Because of these numerous requests, more funding is available, which results in more communities being targeted, especially schools and municipal offices.

Recent El Niño alerts from PEAC have received better attention from the state and national governments. Quick reactions from responsible agencies are more evident, resulting in better socio-economic recovery than for example the 1997–1998 events. There was no loss of life, and shortage of water was quickly managed. Based on the impact of the recent El Niño, the government leaders have been better informed, resulting in better decision making, and the communities are well prepared and more resilient.

Future

The WSO are important sources of meteorological information. Climate services are improving and expanding even though challenges frequently emerge. In the FSM, climate services are essential to help protect lives in the communities. More reliable services support more reliable decisions and increase the trust that the communities have in the providers of weather and climate information.

Public awareness campaign sign located on the main public roadway in Kolonia, Pohnpei, an example of warnings about impending El Nino drought. Photo: NOAA National Weather Service Pacific Region

Coastal Hazard Outlook for the Line Group, Kiribati

Author organisation	The Pacific Community
Contact person's name	Molly Powers-Tora
Contact person's email	mollyp@spc.int; oceanexperts@spc.int
Providers of the service (including partners)	SPC Oceans and Coastal Geoscience, Government of Kiribati, COSPPac monthly climate bulletin
Project timeframe	2014–2016
Location	Kiritimati Island, Line Islands, Republic of Kiribati
Primary target audience	Government decision makers, Line Island public
Funding mechanism(s)	NZ ROSP, COSPPac/Australian Government

Summary

In 2015, a vulnerability assessment for the Line Islands by the Pacific Community (SPC) with the Government of Kiribati noted the significant risk of coastal inundation due to a strong El Niño event. Risk became reality when three flooding hazards combined in early 2016, causing extensive damage and loss of life. The event provided valuable lessons on the effects of El Niño, the need for more ocean data, and the need to build regional forecasting and disaster risk management capability.

Background

Kiritimati Island is the administrative capital of the Line Islands, the eastern-most island chain in the Republic of Kiribati in the equatorial Pacific Ocean. At 388 square kilometres, it has the largest landmass of any raised coral atoll in the world, with a population of just over 5,500 people spread across four villages: Tabwakea, London, Banana, and Poland. Because of its location in the equatorial dry zone, the climate is very variable and sensitive to El Niño/La Niña weather patterns. For example, the annual rainfall on Kiritimati averages 873 mm but can drop as low as 177 mm during La Niña.

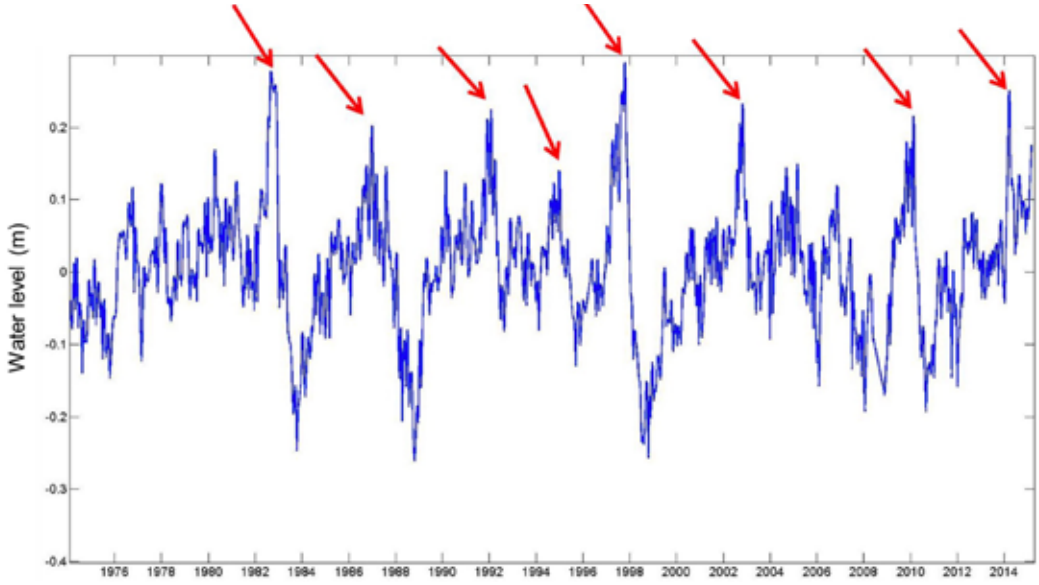
With its reputation for world-class sport fishing and clear weather, Kiritimati has been highlighted by the Government of Kiribati as a potential hotspot for tourism development. Acknowledging that Kiritimati is also highly vulnerable to the effects of climate variability and change, the government requested that the Pacific Community (SPC) Geoscience Division carry out a coastal hazard and vulnerability assessment. The findings would be used to inform urban planning and sustainable development, including, for example, the best location for a new power plant and the ideal placement of schools, hospitals, and other infrastructure around the island.

Methods and Findings

After receiving the request in late 2014, SPC sent a survey team to the island in early 2015 to collect topographic and geospatial data using a range of methods including Unmanned Aerial Vehicle (UAV, also known as a drone) mapping, infrastructure asset mapping, and a geodetic survey.

When the team began to process and analyse existing oceanographic data, they noticed some concerning patterns emerging. Past water-level data available from a tide gauge maintained on the island by the University of Hawai'i revealed a strong relationship between El Niño events and unusually

high water levels. These high water levels also coincided with coastal inundation and erosion events. Over 41 years of records, the mean water levels always peaked during El Niño phases (see figure below) and were the highest during the last two very strong El Niño (1982–83 and 1997–98).



Variation of the mean level of the sea from 1974 to 2015 extracted from the tide gauge at Kiritimati. The red arrows show the water-level peak related to El Niño events.

With the long-range weather outlook predicting a strong El Niño for the end of 2015 and the beginning of 2016, there was a high possibility that the unusually high water levels would return. But there was more: two other phenomena were raising red flags with the team.

First were the highest monthly spring tides and the annual King Tide—the highest spring tide of the year. When the high spring tides combine with the unusually high water level of El Niño, low-lying areas of Kiritimati are likely to be inundated, especially on the lagoon side.

Second were the changes in winter storm systems in the Northern Hemisphere, which make the swells that reach the Line Islands larger than normal. A wave hindcast model (Durrant et al. 2014) showed that 10 of the 30 largest swells to affect Kiritimati were experienced during very strong El Niño events (1982–83 and 1997–98), and 100% of those occurred from November to March. If the predicted high water level happed at the same time as with a swell event, the inundation hazard would increase significantly on the ocean side.

The combination of these factors presented a significant coastal hazard threat in the form of inundation and coastal erosion to Kiritimati Island during an El Niño event, especially from November to March.

By this time, the 2015 El Niño had been declared and was already shaping up to be a strong one, and all the findings from the team were pointing to a high probability of a major inundation in the coming months. The team decided this information could not wait for the final delivery of the project and that these risks needed to be flagged with the Government of Kiribati immediately.

To share this warning, the Oceans and Coastal Geoscience team produced and presented a special report on the Coastal Hazard Outlook for the Line Islands to explain the climate phenomena at work and the potential risks in the months ahead. The outlook also highlighted the high likelihood of coastal hazards, such as inundation and erosion, in late 2015 and early 2016.

Predicted 10 Highest spring high tides for the November 2015 to March 2016 period in Kiritimati	
Date (Local Time)	Tide level (m)
26-Nov-2015	1.20
25-Nov-2015	1.20
24-Nov-2015	1.19
09-Feb-2016	1.18
11-Jan-2016	1.18
25-Dec-2015	1.18
27-Nov-2015	1.18
08-Feb-2016	1.18
12-Jan-2016	1.17
26-Nov-2015	1.17

The predicted 10 highest spring tides for the November 2015 to March 2016 period at Kiritimati.
The water level is referenced to UoH Tide Gauge Zero, which is 0.69 m above Mean Sea Level (calculated over the 1974–2015 period).

Stakeholders

The recipients of the Coastal Hazard Outlook were officials in the Government of Kiribati, notably the Ministry of Fisheries and Marine Resources Development, to whom the outlook was presented in person and explained in detail.

Permanent Secretary for the Ministry of Fisheries and Marine Resources Development, Dr Naomi Biribo, noted that “the Line Island coastal hazard outlook was shared amongst all relevant ministries in Kiribati. This information is critical to us, given the vulnerability of our islands to changes in climate, wave climate, and sea level.”

Outcomes

Because of the heightened risk to the Line Islands from November 2015 to March 2016, a special Coastal Hazard Outlook was produced in November 2015, well in advance of the final vulnerability report. The outlook included the figures presented above as well as tables from SPC wave climate reports and sea surface temperature plots, sea level anomaly plots, and wave hindcast model data from the Australian Bureau of Meteorology. The outlook pointed out the different sources of heightened coastal hazard risk (spring tides and El Niño-induced changes in sea level and waves) and when these risks would be highest. It also recommended that coastal communities and government bodies prepare for the increased inundation risk, especially at times of predicted high tides. Soft copies of this outlook were shared and presented to Government of Kiribati stakeholders.

Unfortunately, the prediction of a significant coastal inundation event during the 2015–2016 El Niño became a reality when large waves, high spring tide, and an unusually high water level coincided. The large waves, however, were not generated by the large storm in the Northern Pacific as expected by the SPC team but by a highly unusual event, Hurricane Pali, only one of three Pacific hurricanes on record to form within five degrees latitude of the equator. Although Pali did not directly impact Kiritimati and the Line Islands, the large waves that the storm system generated did. On 10 January 2016, the ‘perfect storm’ of enhanced sea level, high spring tide, and storm-generated swell combined to produce severe wave inundation, resulting in damage to coastal infrastructure, erosion, and the tragic loss of four lives.

A look at Kiritimati Island during and after severe inundation. Photos: Sunny Seuseu, SPREP

Hurricane Pali was a very unstable system that strengthened very quickly. Hence, forecasting this event would have been challenging under the best of circumstances, and to compound the issue, sources of ocean data are few and far between, particularly in the central Pacific. As a result, the local government had little time and information to adequately react and inform the population.

According to the Director of the Kiribati Meteorological Service (KMS), Mr. Ueneta Toorua, “The Special Coastal Hazard Outlook provided by SPC is very important to low-lying Islands like Kiribati, and I hope it can be continued in future. It enhanced KMS services in terms of provision of ocean and tides predictions. However, there is a need to cooperate on capacity building, research, awareness, and communications to bridge that Coastal Hazard bulletin to the community level so that they can understand the information when it was issued. This gap resulted in tragedy on Kiritimati. Though the warning was issued, it did not reach the majority of the communities, those who received the warning didn’t fully understand the possible risks, and lastly the impacts were worse than expected.”

There have, however, been some constructive outcomes resulting from this disaster. The event has highlighted the need for more hard data and observations on the impacts of El Niño on atolls in the Pacific. It has also generated political will in Kiribati to build capacity in inundation forecasting and to empower government leadership in the Line and Phoenix Islands. The coastal hazard outlook also proved to be a very useful document for the Government of Kiribati and other disaster assessment stakeholders in understanding the origins of this event.

At the request of the Government of Kiribati, SPC performed a follow-up inundation survey to determine the extent of erosion caused, producing a detailed dataset of coastal impacts. Once these data are processed, they will provide important insight into urban planning and decision making for the future of Kiritimati.

Lessons Learnt

This event heightened the need for more and regular observations and more hard data to better understand the impacts of El Niño upon low-lying Pacific atolls. We are learning how dynamic these islands are and the volume of sand that can be removed by a big event like this. The findings of the Kiritimati vulnerability and inundation assessment will provide an important reference for other atolls.

Although awareness of El Niño impacts is increasing in the Pacific, the impacts usually focus on the threats to water supply and food security. The case of Kiritimati, however, demonstrates that we should not underestimate the threats posed by El Niño-induced sea-level rise and associated changes in wave climate.

It is important that SPC and other relevant regional agencies continue to build capacity within the region to forecast such events. The Kiribati Meteorological Service, despite its limited resources, has recognised this fact and is keen to increase and train their staff at the Kiritimati station. Future training opportunities, professional development, and dissemination of outlooks such as this coastal hazard outlook should include outer-islands staff.

It is critical that warnings of this kind be accompanied by tangible, actionable recommendations and, if at all possible, that there be a pool of funding at the national or regional level to support appropriate, locally relevant preparation. An outlook can provide a risk assessment, but unless clear steps or preparation options are outlined, it is unrealistic to expect a nation with limited resources to be adequately prepared for a possible hazard of unknown proportions in only one month.

Future

To date, SPC has only looked at hazards from high water level and sea level rise, but the team also hopes to collect bathymetry data to create a more complete assessment of wave inundation vulnerability.

The Government of Kiribati is also investigating opportunities for SPC to duplicate this study in the neighbouring islands.

SPC and the Government of Kiribati are continuing to work together to complete the requested coastal vulnerability assessment as well as a follow-up inundation survey to determine the extent of erosion and destruction caused by the January 10 event. These studies will serve as a baseline to support decision-making processes on urban planning and disaster preparedness, ensuring that future development progressively lessens the risk driven by coastal hazards.

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Extreme Spring Tide information contributes to disaster risk reduction

Author organisation	Kiribati Meteorological Service
Contact person's name	Mauna Eria, Ueneta Toorua
Contact person's email	uenetat@gmail.com
Providers of the service (including partners)	Kiribati Meteorological Service, Australian Government Bureau of Meteorology, Climate and Oceans Support Program in the Pacific (COSPPac)
Project timeframe	2010–present
Location	Kiribati
Primary target audience	Local government, Community
Funding mechanism(s)	Australian Government (BoM)

Summary

The Kiribati Meteorological Service provides extreme spring tide information to inform the people of Kiribati of impending risks to help with preparedness planning and response. Extreme Spring tide notification is now part of the normal operation, with a one-page information sheet provided for Tarawa once per year, free of charge.

Background

The Republic of Kiribati comprises 33 coral atolls in the Gilbert Islands, Line Islands, and Phoenix Islands. The most densely inhabited island is the capital, Tarawa. People of Kiribati depend on the ocean for food, such as fish, for seashells, and for money earned from selling fish. The highest land on Tarawa is 3 meters above sea level; therefore, these islands are vulnerable to weather and climate conditions.

Extreme spring tides have been identified as one of the major hazards that affect the lives of the people of Kiribati.

During the highest tide of the year 2014, many houses in the village of Ambo in Tarawa were inundated during very fine weather. The flooding was caused by overtopping from the lagoon side. In some houses, a deep freezer, beds, and electric power in the house were damaged, banana plants collapsed, and even coconut toddy for drinking was affected. The underground water well was salty for a very long period.

In 2010 and 2011, there was frequent flooding at Eita village with damage to three well-structured buildings, including the Lagoon Breeze guest house. Later, a spring tide claimed the life of a young child who drowned when swimming in the lagoon. These events inspired the staff of the Kiribati Meteorological Service (KMS) to develop spring tide early warning information.

The KMS has observed the increasing frequency of inundation events and coastal erosion, which are correlated with extreme spring tides. More than 20 extreme spring tides occurred from 2014 to 2015. There are also occurrences of extreme high water level during storm surges or the cyclone season that are not included in the spring tide information. For example, during Tropical Cyclone Pam, an extreme spring tide was reported on 18 to 21 March, but Cyclone Pam damaged properties from 8 to 11 March.

Due to the limited number of KMS staff, only a few extreme spring tides have been collated and analysed.

The main objective of creating an extreme spring tide information sheet was to contribute to awareness and disaster risk management in Kiribati, so that every person, particularly women, children, and disabled people, as well as properties are safe and protected.

The extreme tide information sheet is also aimed to strengthen coordination with disaster risk management units at the national level and to guide policy and decision makers in the short term.

Methods

The extreme spring tide information sheet was developed by the KMS in 2011 based on the tide calendar published every year and disseminated by the Bureau of Meteorology (BoM) in Australia to all National Meteorological and Hydrological Services (NMHS) in the Pacific. This information sheet has been used for 4 years. To produce the extreme tide warnings sheet:

- the Australian BoM sends the tide calendar to the NMHS. The tide calendar is also available on the BoM website or by contacting BoM;
- the local meteorology office identifies the inundation threshold. For example, in our case, 2.8 meters was the threshold based on KMS observation of influential events and the land formation in Tarawa;
- using the tide calendar, an officer from the KMS identifies tides that are 2.8 meters high or more and records these events in another page;
- the date, time, and moon phase of tides with those recorded heights are noted;
- these data are used to create what we call the Spring Tide Information Sheet, a single-page brief;
- this information is distributed to local government (officials) and sent to email contacts; and
- finally, extreme spring tide events are announced over the radio three days before the event occurs.

Spring tide and swells at Betio area in Tarawa. Photo: Kiribati Meteorological Service

Stakeholders

The main targeted stakeholder for the Spring Tide Information Sheet was the local government, but the service is more focused on the community and those living near the coastal areas.

There was no involvement outside KMS in the development of this product, but after the product was produced, more and more people have been accessing the information, heeding the warnings, and adjusting their homes and activities in response. For example, people started building a sea wall during neap tide (first and last quarter of the moon phase). However, there has not been any assessment of other impacts of these seawalls.

There has not yet been a survey to collect feedback information from stakeholders. In 2014, approximately 20 people requested the information sheet in addition to the Australian BoM calendar. In 2015, there has been a 50% increase in information sheet requests. Since the product was started in 2011, the same approach has been effective to date.

Management

This work is now part of the normal operations of the Climate Services Team in Kiribati and of on-going development to support the National Disaster Management Office in every sector, with overall links to the WMO Global Framework for Climate Services. The initiative is managed by the KMS, coordinating information with the assistance from BoM, which provides the tide calendar.

The Climate Services Team of KMS are responsible for providing the extreme spring tide information upon request. Once the spring tide information sheet is finalised with approval from the director, the Station Technical Officer puts the release on the website (www.met.gov.ki) so that all public users with access to internet can download this information. The Forecasting Section is responsible to put out an advisory 3 days before the event on the weather forecast, which will be announced over the radio. The Climate Section is responsible for printing the information and distributing to our stakeholders or people upon request.

The Betio Maternity Ward is affected by Spring Tide and swells. Photo: Kiribati Meteorological Service

Resources

There is a need for an on-going relationship between the BoM and KMS to sustain and maintain our product. There is also need for the timely release of the tide calendar before the end of the previous year to avoid delays in creating and distributing the Tarawa spring tide information.

The KMS office is able to provide the Tide Calendar and Spring Tide Information Sheet to the government and public for free. However, the office and this project would benefit from additional human resources, especially an oceanographer, in the climate section so that he/she can give more detail related to ocean matters. This person should work on the tide calendar and monitor ocean-related patterns and events. He/she might also take photographs and do local research on past extreme tide events. An oceanographer could also communicate with people to learn how spring tides affect the people of Kiribati and could write reports, visit areas, and distribute information. Because the tide calendar is only for Tarawa at present, an extra staff member, ideally with marine science training, could concentrate on developing tide calendars and spring tide information for the other 32 islands. Because BoM sends the complete tide calendar at the end of the year in December or during January, there is often a rush to complete and to issue the information. The expected time required to produce the Tarawa extreme-tide information sheet is 8 hours per day for five days. Someone with a very good background on the ocean would be the most suited to do the job.

There is a need for more tide gauges to be installed on other islands and for more sea-level data so that KMS can generate their own tide calendar. Most of the tide data have been handled by the Australian BoM through their provision of the tide calendar, but if the Australian BoM were to stop providing this information, the people of Kiribati will be affected.

Outcomes

The production of extreme-tide information has contributed to the following outcomes:

- The construction of clinics and water tanks for Abaiang Island and Tarawaieta, North Tarawa, is an ongoing project funded by USAID. This project addresses disaster risk management in outer islands. Participants from the KMS were for the first time part of the team to deliver information related to extreme spring tides. The village people showed interest by approaching and asking for copies of the tide calendar and spring tide information. The USAID project will build water tanks and a clinic, but as a first stage, the meteorology staff provided some awareness products that relate to early warning of extreme spring tides. The local people were able to show locations in their village that were affected more by extreme spring tides straight after the awareness programme.
- The media is one of the key messengers that the KMS uses to release forecasts. KMS releases radio advisories about spring tides so that people who do not get the information directly can hear over the radio and start to move their belongings to the top of their house, away from the incoming flood. These reactions are visible as you pass near their homes, see their preparations, and hear people start to talk to about the news over the radio. Another reaction is that the newspaper staff approach the KMS for news.
- Our website can be accessed by the public for those using the Internet. These people are the ones who send e-mail to us and tell their friends and relatives about the information on spring tide.
- The Kiribati Meteorological Service Facebook page is one way to communicate about the spring tide advisory and improve the ways to prepare and relocate inland. People have started to share the meteorological information with Facebook friends and family in addition to making comments on other Facebook pages about the advisory, attracting the attention of more people.

Lessons Learnt

Since the information was released, more traditional sea walls (buibui) and a permanent sea wall have been built along the coastal areas to avoid inundation and erosion. This reaction demonstrated a shift in attitude by people to minimise the impact of extreme spring tides.

Increasing engagement with local government representatives in workshops, particularly regarding how to use the product in early warning systems, was an effective way to ensure the information was sustainable in the long term.

A standard operational procedure was introduced by weather forecasters as part of their routine during shift hours. This procedure involves monitoring the weather conditions during an event. The extreme-tide advisory delivered 3 days before the event has been included as part of the KMS standard operational procedure.

The threshold of 2.8 meters is generally good, but there were certain times that were not included in the information when a storm surge or swell occurred.

Some people did not understand the English version of the information sheet, so we provided a local language version as well. Highlighting the highest spring tide in the year has attracted the attention of the people, who have started to call the office for more information and started to talk about why these events are happening. People also want to talk about climate change.

Challenges

The primary mode of communication used to communicate our product is radio. The scattered distribution and remoteness of our islands creates major challenges. There are some developments of internet access in other outer islands, but it takes time to load. Mobiles and high-frequency radio are not used in some outer islands.

There are some people who do not believe in science as opposed to their own religious beliefs. Some people do not believe in the ability to warn about tide events, so even though the warning is sent out, the people do not prepare for their safety. This refusal to prepare causes a lot of conflict and fear.

The limited knowledge of staff is a big challenge for the KMS in terms of confidence in preparing this information. There have been times that the forecast has not been distributed, and people became very frustrated.

Outreach programs are one way to communicate to communities but sometimes face difficulties in terms of funding.

Because the BoM calendar is provided only for Tarawa at present, people in the other 32 outer islands are complaining and asking the KMS to provide tide information for them. Despite efforts by BoM to train staff on creating calendars for other islands, using the existing tide calendar by only changing the times for a few islands, like Beru, Kiritimati and Butaritari Island, the KMS staff are not confident yet to do this on their own.

Future

There is a need to continue this operation in the future because of the increased number of inundations and storm surges that affect the people of Kiribati. Stable, strong winds also generate overtopping. The frequency of extreme tide events may also be affected by climate change. The continuity of tidal information in coordination with weather forecasting will ensure preparation for interactions of the ocean and islands in this sensitive nation.

Because the service relies on a key piece of information, the support of the Australian BoM is necessary to keep providing the tide calendar; otherwise, the KMS will stop issuing the information.

KMS is also looking at providing the tide information not only to Tarawa but also for all other islands to help them be prepared. Before such information is provided, an outreach programme should be delivered to ensure successful use of the information.

There are some plans to start developing our own tide calendar, but these cannot succeed until the KMS has its own Oceanographer or staff training on ocean science.

There are plans in Kiribati for a water project, and it is important to be certain that extreme spring tides might not affect the location where the water project will be started; otherwise, the project will fail.

Because Kiribati is among the lowest islands in the Pacific most strongly affected by sea level, knowledge and understanding of monitoring from KMS is needed to safeguard and protect life and properties.

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Annex 1: Tarawa Spring Tide Information Sheet

GOVERNMENT OF KIRIBATI
KIRIBATI METEOROLOGICAL SERVICE
OFFICE OF TE BERETITENTI
P.O BOX 486, BETIO, TARAWA
Telephone Number: (686) 26511, 26459, 25444 Fax Number: (686) 26089
E-mail: kms@met.gov.ki

SUMMARY OF PREDICTED 2015 SPRING TIDES IN TARAWA FALLING WITHIN SEA LEVEL RISK BASED ON HISTORICAL OBSERVATIONS USING BOM TIDAL CALENDAR

MONTH	DATE	TIME	HEIGHT (M)	MOON PHASE
JANUARY	20th	1636	2.85	
	21st	1717	2.91	NEW MOON
	22nd	1759	2.89	
	23rd	1840	2.80	
FEBRUARY	18th	1623	2.87	
	19th	1703	2.94	NEW MOON
	20th	1743	2.92	
	21st	1821	2.81	
MARCH	19th	1604	2.82	
	20th	1644	2.87	NEW MOON
	21st	0505	2.81	
	21st	1723	2.84	
	22nd	0543	2.80	
APRIL	19th	0444	2.80	NEW MOON
AUGUST	1st	0455	2.82	1 DAY AFTER FULL MOON
	2nd	0536	2.84	
	29th	0357	2.80	
	30th	0437	2.89	FULL MOON
	31st	0517	2.90	
SEPTEMBER	1st	0557	2.83	
	27th	0336	2.80	
	28th	0416	2.88	FULL MOON
	28th	1639	2.86	
	29th	0456	2.87	
	29th	1717	2.88	
	30th	1756	2.82	
OCTOBER	26th	1539	2.81	
	27th	1617	2.90	
	28th	1657	2.90	FULL MOON
	29th	1736	2.84	
NOVEMBER	25th	1602	2.84	
	26th	1643	2.85	FULL MOON
	27th	1722	2.81	

Note: From past observations, with spring tides with heights of 2.80 meters or more (obtained through the BoM tide calendar), overtopping and inundation of sea water can be observed in low laying coastal sites along Tarawa. They worsen when associated with windy or gusty conditions.
The causes of spring tides are different from those of storm surges. Storm surges are more related to storm events. Impacts from sea during storm surges can be observed although tide level is less than 2.80 meters.

Role of the Weather Service Office is important for drought response in the Marshall Islands

Author organisation	RMI, National Weather Service Office
Contact person's name	Nover Juria
Contact person's email	Nover.Juria@noaa.gov
Providers of the service (including partners)	NOAA, NWS Climate Services
Project timeframe	2012–2013
Location	RMI, Northern Atolls/Islands
Primary target audience	Other Meteorology Services and the RMI Local Outer Island Communities (Northern Atolls)
Funding mechanism(s)	Core Funding

Summary

Late in 2012 and in the first half of 2013, the Republic of the Marshall Islands (RMI) experienced one of its most severe droughts in recent history. This drought event was more severe than the last two drought events in RMI and caused serious problems for the local communities, especially people living in the northern islands and atolls.

Before and after this drought event, the Weather Service Office in Majuro collected and analysed rainfall measurements from all the available rain gauges in RMI on a daily basis for drought monitoring in collaboration with the National Oceanic and Atmospheric Administration (NOAA) Weather Forecast Office (WFO) in Guam and the Pacific ENSO Application Climate centre in Honolulu. On 20 January 2013, the First *Special Weather Statement* was issued by NOAA WFO Guam in response to the drier than normal conditions in the northern atolls and islands in RMI.

Background

RMI is located just north of the equator in the Pacific Ocean and is made up of 1,200 islands, islets, and atolls with a land area of 180 square kilometres. The islands are divided into group formations, with the eastern groups known as the Ratak ("Sunrise") chain and the Western groups as the Ralik ("Sunset") chain. RMI, like many other countries in the Pacific, faces a high degree of disaster impacts, such as flooding, typhoons, and droughts. Over 50,000 people live in RMI, and most of the population lives on the two main islands: Majuro atoll in the south and Kwajalein atoll in the north.

The Weather Service Office (WSO) in Majuro provides meteorological and climate information to the population in collaboration with the Weather Forecast Offices in Guam and Honolulu to help the decision-makers in RMI plan and make informed decisions regarding the climate risks in the country.

The WSO in Majuro has a total of 12 staff and is responsible for:

- supervising one Supplemental Aviation Weather Reporting Station, five Second Order Synoptic Stations, and two Cooperative Observer Program (COOP) stations;
- operating these stations in RMI in cooperation with the US NOAA National Weather Service, Pacific Region Headquarters; and
- taking daily rainfall observations.

Methods

The rainfall measurements collected from the outer islands were used by the WSO for its daily and weekly briefing to the National Disaster Committee. These measurements are made daily by eight second-order stations in the RMI, only two of which are in the northern islands (Utirik and Wotje). There are three stations in the central islands (Ailinglaplap, Kwajalein, and Jaluit) and three in the southern islands (Mili, Arno, and Majuro atolls).

Based on the rainfall outlooks from the Weather Forecast Office in Guam, the WSO produced a *Drought Information Statement* for RMI, especially to the Disaster Management Committee for decision making and planning. This kind of communication follows the standard operating procedures established between the RMI government and the WSO. Following persistently low rainfall during the dry season, RMI declared a *State of Emergency* for the northern atolls on 19 April 2013 and elevated it to a *State of Disaster* on 7 May 2013.

Stakeholders

During the drought event, key agencies became involved to monitor the drought as it lasted.

The local outer island communities (in the northern atolls) were the most affected communities in RMI.

The RMI local government took action and planned for the drought event.

The NOAA National Weather Service and WFO Guam conducted drought analyses for RMI and produced statements regarding the drought situation.

RMI National Weather Service provided data to the NOAA staff to prepare drought analyses for RMI and subsequently received information and interpreted the findings to the Disaster Management Office at the government level.

Other nongovernmental organisations assisted in writing other funding reports for the drought relief.

Management

The WSO struggled with data collection and analysis due to lack of equipment, such as rain gauges, but still managed to complete some of the required work by ‘extrapolating’ data, using rainfall data from neighbouring islands to estimate the rainfall on islands without gauges.

The WSO also had some issues with communications, which should follow the standard operating procedures established between the RMI government and the WSO. After the WSO provides information to the Disaster Committee, the Disaster Committee takes further actions with planning.

Resources

The resolution of precipitation data and information about precipitation patterns and intensity was poor. This limitation can be directly attributed to the fact that there were only two gauges in the northern islands of RMI (Utirik and Wotje), three in the central region, and two in the southern atolls and islands. Only monthly data were provided from Arno due to limited communication, requiring a phone, radio, and a Chatty Beetle system. Rainfall datasets for the some outer-island gauges have gaps, and it was difficult to derive accurate climatological normal and means tabulations. Accurate weather services rely on sufficient, accurate data, and more physical resources are needed for RMI to have better weather services.

Outcomes

The rainfall outlook forecasts provided by the WSO were used by the Disaster Management Committee to determine locations for pre-positioning of portable Reverse Osmosis Units.

The RMI weather service office is still reliant on NOAA WFO and Pacific ENSO Applications Climate (PEAC) products and services. Currently, RMI is part of the Online Climate Outlook Forum monthly conference and will continue using the other products and services provided by the Australian Bureau of Meteorology and Climate and Oceans Support Programme in the Pacific (COSPPac).

Lessons Learnt

Information management makes for more efficient responses.

Daily rainfall measurements are crucial in supporting water management and relief works. Most computer models require daily/hourly or minute time scales to generate reliable forecasts.

Due to the lack of rain-gauge coverage at the northern atolls/islands, the WSO sometimes had to rely on an 'extrapolating function' to get forecast results for points within RMI without rainfall information.

Outreach and education at the community level are vital.

There is a need for more observation points and more rain gauges to cover all of the atolls.

There is a need for longer precipitation datasets for the RMI outer islands to obtain more accurate normal and means tabulation of the precipitation, requiring:

- employment of a temporary climate officer to assist with the WSO Climate Program;
- continued maintenance and upgrading of the WSO's in-house database (CliDE) and other climate software, such as SCOPIC; and
- installation of more observation sites (manual or automatic).

There is a need for continued staff development and training to:

- continue to develop the WSO Climate Services Program; and
- continue to engage the WSO two Climate Focal Points in capacity building and training.

Drought impacts on various crops including bananas and pawpaws. Photo: Karl Fellenius, University of Hawaii Sea Grant College Program (at the College of the Marshall Islands)

Future Plans

The RMI WSO plans to:

- install more standard rain gauges:
  - Five gauges have already been obtained and are waiting for installation.
  - The present approach is to install meteorological instruments at the government health dispensaries in the outer islands.
  - To obtain and install the required equipment, the RMI WSO is seeking assistance from donor partners and regional programs.
- install automated sensors to free-up staff time and improve data quality;
- pursue forecaster and climatologist trainings to train the WSO staff to produce better and more accurate weather and climate predictions;
- install Chatty Beetle communication systems on five to eight other atolls or more;
- employ and train another Climate Officer through COSPPac support to assist in the WSO Climate Services Program;
- provide locally tailored climate products to the public; and
- commission two more second-order stations and four more COOP stations.

Summary

The US and RMI National Weather Service provide forecast and monitoring support prior to and during drought events, supporting the in-place disaster response mechanisms.

Drought impacts on Ailuk Atoll. Photo: Jacob Applebaum

Using climate information to assist malaria monitoring and control

Author organisation	Solomon Islands Meteorological Services
Contact person's name	Lloyd Tahani
Contact person's email	l.tahani@met.gov.sb
Providers of the service (including partners)	Solomon Islands Meteorological Services (Ministry of Environment), National Vector Born Disease Control Program (Ministry of Health), COSPPac – Bureau of Meteorology, Australia
Project timeframe	2012–2016
Location	North Guadalcanal, Solomon Islands
Primary target audience	NVBDCP, Solomon Islands communities
Funding mechanism(s)	COSPPac, Bureau of Meteorology, Australia

Summary

Malaria remains a leading cause of morbidity and continues to put pressure on socioeconomic costs in the Solomon Islands despite a drastic reduction in incidence over the past decade due to an effective national control strategy. The temperature and humidity in the Solomon Islands provide ideal living and breeding conditions for the malaria parasite and its mosquito vector.

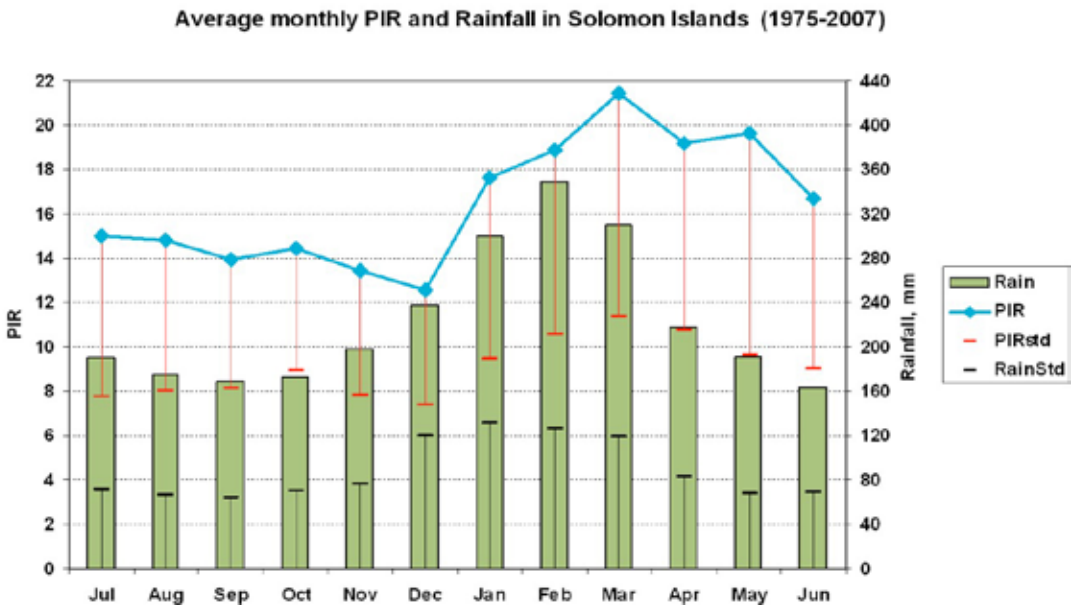
Responding to the challenge, the Solomon Islands Meteorological Service (SIMS) and the Solomon Islands National Vector Born Disease Control Program (NVBDCP) in collaboration with the Australian Bureau of Meteorology (BoM) developed a rainfall-based malaria monitoring and outlook service for northern Guadalcanal called MalaClim. This is part of the Climate and Oceans Services Support Program in the Pacific (COSPPac), which is a five-year programme funded by the Australian Department of Foreign Affairs and Trade. Outlooks were used as an early warning system to initiate preparedness actions (community awareness, diagnostic and treatment tools allocation, and vector control activities) in advance of a more active than normal malaria season and provided up to four months before the beginning of the season.

The outlook information has improved malaria control by providing the health system with advance warning up to four months for enhanced risk of malaria epidemics and will help enhance control activities in the highest risk areas. Spatial analysis using GIS tools was also used to produce malaria risk maps showing the regions of the Solomon Islands most at risk of malaria transmission.

Background

Variability in malaria incidence is known to be strongly linked with climate and weather. The use of rainfall and temperature indices to monitor malaria transmission is an area of growing scientific and operational interest.

The relationship between climate and malaria is very complex. Seasonal rainfall plays a very important role in the spread of malaria because certain amounts of water create ideal breeding habitats for mosquitoes. Typically, a peak in the number of cases of malaria occurs 1 to 2 months after the wet season, which extends from May to June. Malaria claimed 18 lives in the Solomon Islands 2013 (WHO, World Malaria Report 2014, http://www.who.int/malaria/publications/country-profiles/profile_slb_en.pdf).



The relationship between rainfall and monthly parasite ratio (PIR)

During an El Niño year, which is typically drier than normal in the Solomon Islands, the average number of detected malaria cases tends to be higher, whilst during La Niña years, which are typically wetter than normal, the average number of detected malaria cases is lower. Spatial analysis can also be used to determine where the risk of malaria transmission would be highest.

Notable successes in malaria elimination have been achieved in the provinces of Isabel and Temotu, which are now considered to be in the malaria pre-elimination stage. However, in other parts of the country, including the heavily populated provinces of Guadalcanal, Malaita, Central, and Honiara, the impact of malaria remains substantial.

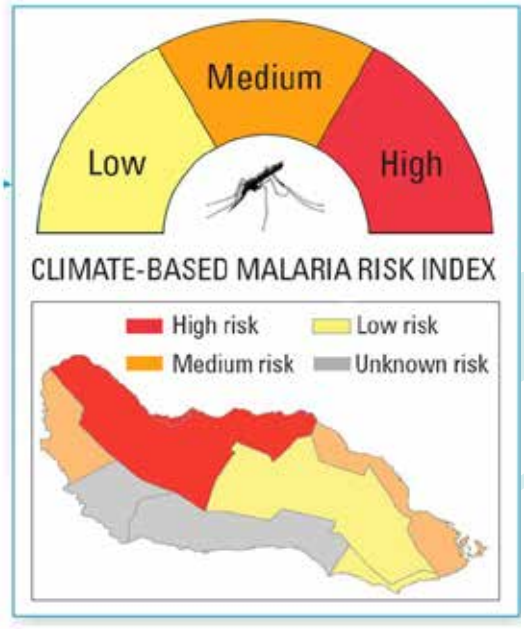
The northern Guadalcanal region on Guadalcanal Island was identified as the site for a case study due to availability of data, physical accessibility, availability of previous research to build on, and the high relative malaria incidence. Northern Guadalcanal also has unique hydrological characteristics that make rainfall a particularly important driver of malaria variability.

Through the monitoring and control activities of the Solomon Islands National Vector-Borne Disease Control Program (NVBDCP), substantial progress has been made on malaria control over the past decade, but malaria reductions have stalled in some high-incidence areas. The use of climate information can help understand differential risks across the islands and improve access to quality health care in regions that are at highest risk.

Methods

A strong partnership has been established between NVBDCP and SIMS through regular consultations, reporting, and sharing of data. This partnership has resulted in rapid project implementation, despite lack of human and material resources in health centers and weather stations.

Seasonal malaria variability analysis was undertaken by the COSPPac technical experts, in partnership with NVBDCP and SIMS. They analysed the relationship between rainfall and malaria in northern Guadalcanal and developed a system for producing malaria transmission outlooks for this region. Malaria risk maps were developed for other regions of the Solomon Islands using a number of climate and environmental parameters associated with malaria transmission. These maps were provided to the NVBDCP for integration into the malaria spatial information system.



Prototype of Malaria risk map for Guadalcanal

1. Exchange of data and information

SIMS and VBDCP provided key climate and malaria data to COSPPac in order for the relationships between climate and malaria to be scientifically explored.

2. Scientific analysis

COSPPac scientific experts, in collaboration with SIMS and NVBDCP staff, found that the relationship between rainfall and malaria in northern Guadalcanal was particularly important, consistent with previous research and observations. This allowed for a malaria transmission index to be produced showing the direct link between climate and malaria transmission.

3. Relationship building and strengthening

Several meetings and workshops were undertaken in Honiara, Solomon Islands, from 2013 to 2015 between COSPPac, SIMS, and VBDCP staff, allowing the exchange of ideas on how climate and malaria services could work together to improve malaria control outcomes.

4. Development of operational tools

Tools were developed to allow SIMS to produce customised forecasts of malaria risk for suitable regions of the country. The NVBDCP were provided with spatial malaria transmission risk maps and analysis.

5. Implementation of system

Combining the seasonal rainfall forecast outlooks and malaria transmission index enables SIMS to produce customised monthly transmission risk forecasts of malaria for suitable regions of the country. Climate information is now integrated into the NVBDCP malaria information systems to assist with the malaria monitoring and control efforts.

Stakeholders

Health was identified as one of the most crucial sectors in Solomon Islands because malaria is one of the diseases that pose greater health risks in the communities. Malaria is one of the leading causes of morbidity in the Solomon Islands and is identified under the Solomon Islands' Climate Change National Adaptation Plans for Action (NAPA) and the World Meteorological Organization (WMO) Global Framework for Climate Services (GFCS).

Since the inception of the project, the NVBDCP has been actively involved in the development process of the project by providing malaria case data and other relevant information about malaria monitoring and control programs in the Solomon Islands.

Partnership between Solomon Islands Meteorological Service and the Ministry of Health formalised through the signing of an MOU. Photo: Lloyd Tahani, Solomon Islands Meteorological Service

Several face-to-face consultation meetings and workshops were held with NVBDCP staff members. Regional Health Centre operation managers from the field were brought to Honiara for an exchange of information and training on how to understand and use the seasonal rainfall outlook and malaria transmission index. This connection helped to develop mutual confidence in using MalaClim early warning products.

Occasional teleconferences are organised by COSPPac, SIMS, and NVBDCP as a mechanism to discuss the progress of the project and feedback on the MalaClim outlooks. Other means such as email are also used to share information and updates on the progress of the project.

Management

The project was funded by AusAID, now the Australian Department of Foreign Affairs and Trade (DFAT), as part of COSPPac. COSPPac is a regional programme implemented through the Australian BoM that is designed to provide capacity development and scientific support to climate and ocean services in the South Pacific region. The Solomon Islands' climate and malaria project is a case study on the use of climate information to improve socio-economical outcomes in climate impacted sectors as part of this over-arching project.

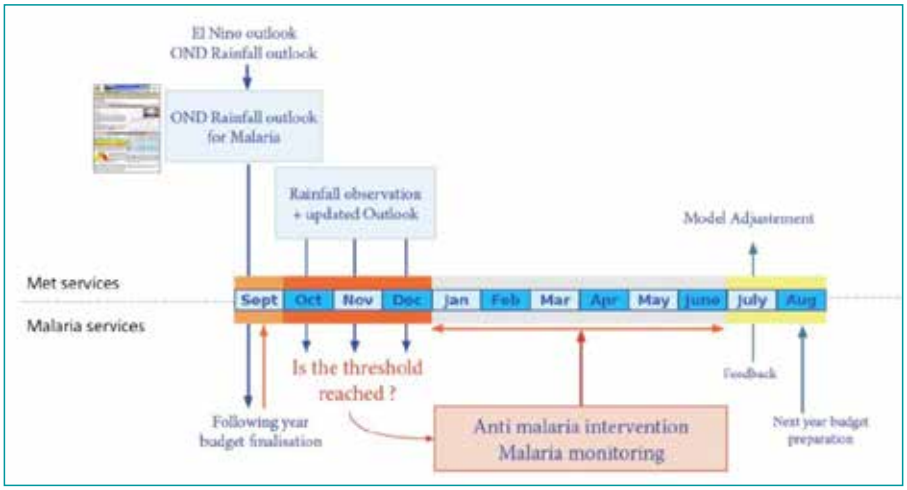
Decisions on the selection of case study projects were made through the COSPPac steering committee meetings, which involve all the directors of the Pacific island countries' National Meteorological and Hydrological Services (NMHS). Different case studies were conducted in various Pacific island countries according to individual government and NMHS priorities. Peer review consultations and evaluations were conducted with SIMS once a year on the progress of the project activities and outcomes.

Resources

COSPPac provided technical and scientific support on climate and malaria analyses, while NVBDCP and SIMS provided data during the development phase of the project. Seasonal forecasting tools and equipment to tailor forecasts of malaria risk were provided to SIMS' Climate Services, and malaria risk maps and analysis were provided to NVBDCP. National resources provided by SIMS and NVBDCP through their operational budgets will supplement the operational phase of the malaria early warning system.

Lack of rainfall data as well as human and material resources pose a constraint. However, since the commencement of the project, SIMS and NVBDCP have been working together to begin installation of 16 new rain gauges next to health centers in the project areas.

Outcomes

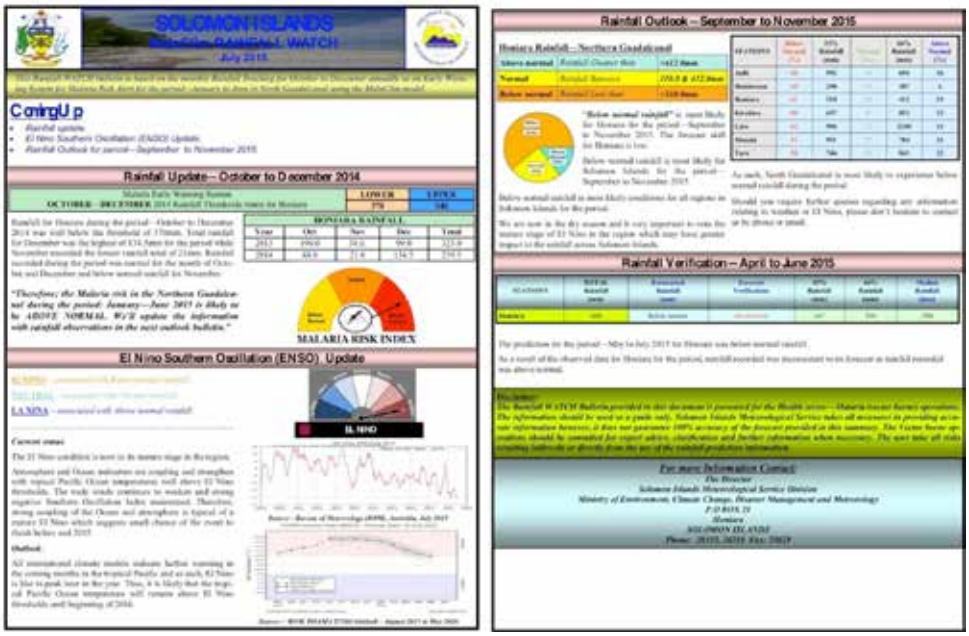


Rainfall based – malaria monitoring and early warning system for north Guadalcanal

A pilot season was launched in September 2014 with a release of a rainfall-based malaria transmission outlook for north Guadalcanal for the next malaria season in January to June 2015. The operation of the MalaClim was formally launched in November 2015.

The outcomes of the project have largely gone according to plan. The project has improved the malaria monitoring and control programme by providing the health system with forecasts of likely periods of higher malaria transmission, up to four months prior to those periods. It has also helped to allow enhanced control activities in the high risk areas.

SIMS manages the media-awareness program, while the health team (NVBDCP) leads the community level awareness and control interventions. Media releases are shared with NVBDCP staff in collaboration with COSPPac for approval prior to release.



SIMS – MalaClim Rainfall Watch product

Lessons Learnt

A strong partnership between NVBDCP and the SIMS was essential for the implementation of the project. Lack of human and material resources in health centers and sparse weather stations were a challenge.

Installation of 16 rain gauges in the health centers will complement required data for the operation of the MalaClim outlook for each specific zone in the islands.

Capacity development of national climate services in such undertakings requires tangible collaboration with stakeholders and donor partners. Forecasting tools, climate analysis, and expertise are essential.

The need for forecasting tools was addressed by the COSPPac project.

To address the lack of human resources and skills in seasonal forecasting, this project employed one officer, trained by the COSPPac project and other partners.

Future

The implementation of an operational malaria early warning system further strengthens the relationship between the SIMS and the NVBDCP through the use of climate forecasts for the health sector for monitoring, forecasting, and management of malaria. Integrating seasonal climate forecasting into malaria control strategies contributes toward the eventual goal of malaria elimination in Solomon Islands.

Budgetary support and human resources provided by SIMS and NVBDCP has complemented the successful implementation of this project.

The success of this project has stimulated future projects in other sectors. Food security is becoming a concern due to human-induced climate change, with climate variability introducing a new complicating factor into the food security equation. A similar approach in agriculture and food security as the climate early warning system for malaria is essential for food production. Accurate, reliable, and timely weather and climate information for daily decision and long-term planning is crucial because year-to-year climate variability has a large influence on agriculture, which is heavily dependent on rainfall, sunshine, and temperature.

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Unfavourable conditions such as this may lead to higher risk of malaria. Photo: Christina Leala-Gale, SPREP

SPREP

Secretariat of the Pacific Regional Environment Programme