

Community-based Early Warning Early Action (EWEA) in the Pacific:

Findings from Tuvalu

Red Cross Red Crescent Climate Centre

31st July 2022

Acknowledgements

Research Team: The team was made up of researchers from the Tuvalu Red Cross Society (TRCS), University of the South Pacific (USP) and the International Federation of Red Cross and Red Crescent Societies (IFRC) as well as experts from the Red Cross Red Crescent Climate Centre and the University of Oxford's internship programme. The team was coordinated virtually due to COVID-19 travel restrictions and spanned seven countries (Fiji, Geneva, New Zealand, Palau, Tuvalu, the United Kingdom and Vanuatu). The research was made possible with support from the Government of Liechtenstein. The team would like to thank all the Tuvalu interviewees, community members and partner organizations for taking part in this research.

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About the research

The research study on **Community-based Early Warning Early Action (EWEA)** in the Pacific has explored opportunities for strengthening EWEA in the Pacific, focusing on understanding local practices at the community level, while recognizing that these are often shaped by national and regional policy frameworks. It seeks to capture evidence on impacts as well as response mechanisms and identify ways to strengthen and build on these models. Research was conducted in two countries, Tuvalu and Palau, that were chosen as case studies to document existing strengths of EWEA systems on the islands. This information is expected to inform and shape the early stages of the Green Climate Fund (GCF) programme “Enhancing Climate Information and Knowledge Services for resilience in 5 island countries of the Pacific Ocean” due to start in 2022. Separate reports have been developed on the findings from the research in Tuvalu and Palau. This report focuses on drought and EWEA in Tuvalu.

Data that forms the research in Tuvalu was collated through desk reviews, household surveys, key informant interviews and community focus groups as well as consultations with Pacific Country Cluster Delegations, Red Cross National Societies and other key stakeholders in Tuvalu.

About the GCF project

The GCF project identified that as Small Island Developing States (SIDS) in the Pacific, Cook Islands, Niue, Palau, the Republic of the Marshall Islands (RMI), and Tuvalu are at the forefront of increasing risks from the impacts of climate change. The GCF project seeks to address these issues with the facilitation and development of integrated climate and ocean information services and people-centred multi-hazard early warning systems (MHEWS) via inter-related project components such as: i) strengthened delivery model for climate information services and MHEWS covering oceans and islands; ii) strengthened observations, monitoring, modelling and prediction of the climate and its impacts on oceans and islands; iii) improved community preparedness, response capabilities and resilience to climate risks; and iv) enhanced regional knowledge management and cooperation for climate services and MHEWS.

The GCF project will seek to engage with last-mile communities to enhance preparedness and response actions at the grassroots level. The proposed interventions will focus on knowledge and capacity building to support the adoption of climate-resilient livelihood practices. This will be facilitated by the development of community-based disaster risk reduction and management plans, community level multi-hazard vulnerability assessments, assessment of community-level communications and response actions, and training and awareness workshops to enhance awareness of climate hazards and risks. This research aims to provide guidance on pathways for strengthening countries’ community resilience in the following ways:

- Introducing Forecast-based Financing (FbF) in Cook Islands, Niue, Palau, RMI and Tuvalu.
- Showcasing FbF as an innovative mechanism whereby early actions are pre-planned based on credible forecasts and are funded and implemented before a climate shock to minimize losses and damages caused by climate-related hazards and reduce the need for humanitarian assistance in their aftermath.

- Developing FbF Roadmaps defining thresholds and triggers through stakeholder identification, risk assessment, impact-based forecasting (trigger analysis) and a resourcing overview.
- Capacity building for FbF involving research collaboration, technical support, EWEA activities, region-wide connections, table-top exercises, and financing mechanisms.
- Support on the development of Early Action Protocols (EAPs).
- Monitor and track where FbF mechanisms (with impact-based forecasting) can be a transformative means of improving disaster preparedness and enabling more efficient management of government budgets to promote the shift from traditional post-disaster response to pre-event early action.

Volunteers from the
Tuvalu Red Cross
involved in the data
collection for the study
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Abbreviations and acronyms

CCA	climate change adaptation
CCDRR	climate change and disaster risk reduction
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CREWS	Climate Risk & Early Warning Systems
DCC	Development Coordinating Committee
DDM	Department of Disaster Management
DREF	Disaster Response Emergency Fund (Red Cross)
DRM	disaster risk management
DRR	disaster risk reduction
EAPs	Early Action Protocols
EARWatch	Early Action Rainfall (EAR) Watch
EWEA	Early Warning Early Action
FbF	Forecast-based Financing
FGD	focus group discussion
FINPAC	Finnish-Pacific Project
GCF	Green Climate Fund
IDCs	Island Disaster Committees
IFRC	International Federation of Red Cross and Red Crescent Societies
INGO	International non-governmental organization
IPCC	Intergovernmental Panel on Climate Change
KII	key informant interviews
LDCs	Least Developed Countries
LLEE	live & learn environmental education
MHEWS	Multi-Hazard Early Warning Systems
m/s	metres per second
NAPA	National Adaptation Programme of Action
NDC	National Disaster Committee
NDMO	National Disaster Management Office
NDPWG	National Disaster Preparedness Working Group
NGO	non-governmental organization
NSAP	National Strategic Action Plan for Climate Change and Disaster Risk Management
NSDP	National Sustainable Development Plan
PACC	Pacific Adaptation to Climate Change
PICs	Pacific Island Countries
PIEMA	Pacific Islands Emergency Management Alliance
PWD	Public Works Department
RMI	Republic of the Marshall Islands
SIDS	Small Islands Developing States
SOPs	Standard Operating Protocols
SPREP	Secretariat of the Pacific Regional Environment Programme
SREM	Strategic Roadmap for Emergency Management
TC	tropical cyclone
TRCS	Tuvalu Red Cross Society
TSF	Tuvalu Survival Fund
TTF	Tuvalu Trust Fund
UNFCCC	United Nations Framework Convention on Climate Change
USP	University of the South Pacific
VRK	Value Rules Knowledge Framework
WASH	Water, Sanitation and Hygiene
WMO	World Meteorological Organization

Definitions

Here are some of the terms used frequently in this report:

Drought: The Intergovernmental Panel on Climate Change (IPCC) defines drought as “a period of abnormally dry weather long enough to cause a serious hydrological imbalance,” noting, “drought is a relative term; therefore any discussion in terms of precipitation deficit must refer to the particular precipitation-related activity that is under discussion” (IPCC, 2014, p. 1763). The IPCC definition of a meteorological drought is “a period with an abnormal precipitation deficit” (IPCC, 2014, p. 1763).

Early Warning Early Action: ‘Early Warning’ means having the type of appropriate risk information, including traditional knowledge, for a wide variety of potential hazards including cyclones, droughts, floods and storms. ‘Early Action’ – also known as ‘anticipatory action’ and ‘forecast-based action’ – means taking steps to protect people before a disaster strikes based on early warning or forecasts. To be effective, it must involve meaningful engagement with at-risk communities (IFRC and Red Crescent Societies 2022).

Kaupule: The Kaupule is the island council, an island court with specific powers, and is responsible for approving the construction of houses or extensions to existing buildings on private land. The Lands Management Committee is the responsible authority in relation to lands leased by Government.

Knowledge is defined as “the mix of evidence-based (scientific and technical) knowledge and experiential, meanings-based knowledge that forms part of constructed knowledge systems in the decision-making process” (Gorrdard *et al.*, 2016). Decision-makers make decisions based on the level of knowledge they have access to and the types of knowledge they choose to privilege: “Knowledge-based power is exercised in decision-making by preferencing some forms of knowledge over others; for example, the use of community-held knowledge of effects of past disasters over use of technical expertise to model changes” (Colloff *et al.*, 2018).

Rules include both ‘rules in use’ and ‘rules in form’, which relate to informal and formal rules respectively. The former includes norms, practices, taboos, habits and heuristics. The latter includes regulations, legislation, treaties and ordinances (Gorrdard *et al.*, 2016).

Values are defined as “a set of ethical precepts that determine the way people select actions and evaluate events” (Colloff *et al.*, 2018; Gorrdard *et al.*, 2016). Values are “important in determining our goals, world views, actions and preferences.” Values can be influenced by factors such as tradition, culture and beliefs.

Executive Summary

The research study on understanding community-based Early Warning Early Action on the island of Tuvalu was conducted from December 2021 to March 2022. The study relied on qualitative research techniques using tools such as focus group discussions (FGDs) and key informant interviews (KIIs). The study finds that households in Tuvalu have developed different coping strategies to try and prepare for a range of climate-related hazards. Their commitment to protecting their families and assets remains high and they are already doing what they can with the resources and information currently available to them.

1. Most households reported cyclones as the major hazard of concern and the study found households to be most prepared for them. This is because there is a good early warning system on the cyclone's landing time, strength of wind and direction available to help households prepare in advance. Being most prepared does not mean households will avoid being impacted by the cyclone, though. The ability of households to prepare effectively and act early strongly depends on their resources and socioeconomic status.
2. Drought was the second hazard of concern, but households were found to be the least prepared for it. This is mainly because of the lack of certainty on when a drought starts, when it will end, and how much rainfall to expect during the drought period. Households shared the limits of their early actions to reduce the impacts of droughts on water security, food security, health and their livelihoods. Households are not currently able to increase their water storage capacity or manage their water use to outlast the drought. These two factors are the most important actions for increasing drought resilience.

For *fast-onset hazards* like cyclonic storms, and associated storm surge and flooding, known preparedness strategies at the household level include listening to early warning advice on the radio, ensuring homes and assets are as secure as possible, moving to safer locations until the cyclones have passed, and having sufficient stored food and water for up to three days.

The study found that information on cyclones is provided in a timely manner from sources people trust, allowing those with the resources to act in advance. Other preparedness measures that can be put in place include improving construction requirements for ensuring the long-term durability of buildings, integrated land use planning, stronger sanctions for construction in hazard-prone zones and providing support through relocation.

For a *slow-onset hazard* like droughts, coping strategies used by households include investing in water storage facilities, reducing water consumption and recycling water. The study found that information regarding the onset of drought is not timely. Interviewees reported not knowing forecast information on expected rainfall, timing or duration; and, as such, were unable to make decisions on water recycling actions, water management or other preventive measures. It was found that households do not receive information on an impending drought until they already start experiencing water shortages.

Most families in Tuvalu – which is almost completely reliant on rainfall as the main source of fresh water – rely on tanks for harvesting rainwater. While this is adequate during a normal season, insufficient rainwater storage is a major challenge for households in Tuvalu when preparing for droughts. The households also reported interest for building skills, information and awareness related to the sustainable management of stored water as well as its maintenance over longer drought periods. This can be further compounded when drought follows another

hazard such as storms, strong winds and cyclones that have already damaged water storage infrastructure (Ilese et al, 2021). High winds can damage the existing storage systems preceding a period of drought, reducing capacity for water capture significantly. Harvesting rainwater during these events is critical for households to have the opportunity to catch and store sufficient rainwater to manage the drought ahead. Hence, compounding hazards exacerbate the lack of water storage capability.

This has critical implications for the post-disaster response in Tuvalu, where early recovery activities are currently focused on providing food, hygiene, livelihoods support, shelter and meeting immediate water and sanitation needs. More research is needed on how to incorporate preparedness efforts for multi-hazards into post-disaster recovery programmes. This could, for instance, include community training for imparting repair and maintenance skills for household-level water harvesting systems. Support in the form of grants or microcredits can also be beneficial for households seeking to expand on their rainwater harvesting infrastructure. Additionally, timely information on expected droughts and other forecast information should be delivered ahead of time.

The study finds that women, who are primarily responsible for managing domestic water use within the household, felt least prepared for droughts, whereas men felt least prepared for cyclones as they are more actively engaged in mitigating the latter. Support from programmes and information should therefore be tailored to reach women and men as separate target groups, based on gender-specific needs and vulnerabilities.

Introduction

Due to impacts from climate change and intensifying climate events, managing disaster risks through a well-designed and functional Early Warning Early Action (EWEA) is critical in this region. Ensuring that communities have access to appropriate information and can act in disaster contexts is a high priority. While many Pacific nations already have EWEA initiatives in place, these systems are not always accurate or reliable. One of the primary objectives of IFRC National Societies in the Pacific is to make anticipatory action a central pillar of disaster risk reduction in the region over the next decade. This research project advances that goal by examining the effectiveness of EWEA systems in Tuvalu, and the experiences of communities in accessing and using these systems. It offers a unique opportunity to assess the existing EWEA landscape in Tuvalu and identify potential paths forward.

The first part of the report gives an overview of available literature and the methodology to outline the research background and provide the context for the study findings. The section on findings from data collection has been divided into four main sections:

- i. an overview of the disaster and climate context in Tuvalu
- ii. an overview of policy and practices that influence EWEA interventions and approaches
- iii. a summary of overall research results
- iv. recommendations and opportunities for stakeholders in Tuvalu.

Literature review

Climate change poses serious risks to Tuvalu. Since 1992, the United Nations Framework Convention on Climate Change (UNFCCC) has defined climate change as “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere.” The Intergovernmental Panel on Climate Change (IPCC) defines climate change as “a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer” (IPCC, 2014, p. 1760). However, it is important to note that the specific term “climate change” is a relatively recent one, born out of Western scientific discourse and lacks a direct translation or equivalent in many Pacific languages. Equally, indigenous scholars in the Pacific region have noted that many Pacific terms for ontological conceptualizations of the environment lack a direct equivalent in English (Tiatia-Seath *et al.*, 2020, p. 402). While specific terminology around climate change may vary geographically and culturally, hazards that are being exacerbated by climate change – such as increased instances of saltwater inundation, more severe cyclones, and ongoing dry-spells and droughts – are familiar hazards to inhabitants of the South Pacific, even if not explicitly identified as impacts of climate change (Tiatia-Seath *et al.*, 2020, p. 404).

The IPCC defines disaster as “severe alterations in the normal functioning of a community or society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery” (IPCC, 2014, p. 1763). The IPCC definition of a hazard is “The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources.” The IPCC also notes that in the context of its work, the term ‘hazard’ typically refers to specifically climate-related physical events and their impacts (IPCC, 2014, p. 1766).

The impacts of climate change and related hazards in coastal communities have been well-documented in the Pacific. The nature and extent of impacts vary widely across social groups, with factors such as age, class, gender and disability playing complex and significant roles in outcomes related to hazards (World Bank Group & Asian Development Bank, 2021a, p. 15). Those who are already most vulnerable, including particular age demographics (such as children and the elderly), low-income communities, people with disabilities, and those facing other kinds of discrimination are at the greatest risk (Miles *et al.*, 2020, p. 27). Some examples of the impacts of hazards on vulnerable populations in Tuvalu, as found in the literature, are listed below:

- **Heat-related health concerns:** As the number of hot days increases and cool nights decrease in frequency, heat stroke and other heat-related issues are a concern. Children experience higher rates of these illnesses than adults (Miles *et al.*, 2020, p. 27).
- **Food insecurity:** Food insecurity can be exacerbated by many hazards; in Tuvalu, drought is one major concern. The lack of extensive irrigation infrastructure means that droughts can cause food insecurity and shortages in Tuvalu, where subsistence agriculture is widespread (World Bank Group & Asian Development Bank, 2021b, p. 13).

- **Heightened risk for disabled people:** People with disabilities are at greater risk of infrastructural hazards during extreme events such as storms, which can cause power outages. They may also struggle with mobility during evacuation processes (Miles *et al.*, 2020, p. 27).
- **Infrastructural damage and disruption of crucial services:** In the wake of storms, infrastructure and housing may be damaged, meaning that “lifeline infrastructure”—electricity, sanitation, safe food and drinking water supplies, transportation and communication systems – may be disrupted (Miles *et al.*, 2020, p. 32).
- **Increased risk of disease:** Warming temperatures and changes in precipitation patterns have been linked globally to the increased spread of diseases by strengthening the incubatory habitats of pathogens and vectors (especially mosquitoes). Illnesses that are likely to increase due to the impacts of climate change include dengue fever, diarrhoea, malaria and salmonellosis (Miles *et al.*, 2020, p. 32). (World Bank Group & Asian Development Bank, 2021b, p. 13)
- **Mental health concerns:** Climate change and its impacts have been found to worsen mental health in the Pacific region and elsewhere. In a literature review on the linkages between climate change and mental health for Pacific peoples, Tiatia-Seath *et al.* (2020) found that trauma resulting from hazards, economic insecurity and the threat of forced relocation – along with more complex experiences of grief over loss of connection to place – are some of the most widely cited mental health impacts of climate hazards in the Pacific. Globally, coastal and circumpolar communities have been identified as particularly at risk of these mental health impacts. Building upon these findings, Tiatia-Seath *et al.* found that comprehensive understandings of wellness and wellbeing that include spiritual and cultural wellness are a strength of indigenous ontologies in the Pacific, and that initiatives aimed at improving wellbeing in the face of climate change must be informed by local interpretations of wellness.

Understanding these risks and the range of impacts is key to building anticipatory systems that can respond to the needs of vulnerable communities. Based on this aim, the methodology of the study has been designed to ensure that the findings are representative and can feed into future policy and programming.

Community Focussed
Group Discussions held
to validate findings of the
study © Tuvalu Red Cross

Methodology

This research aims to describe a country-specific approach to EWEA in Tuvalu and inform the strengthening of community-level outcomes. This report includes the details of the Tuvalu project, including the literature review, methodology, policy and legal frameworks, research findings and lessons and recommendations for future EWEA development. Based on the findings, strategic and informed recommendations have been developed to support the upcoming Green Climate Fund (GCF) project entitled “Enhancing Climate Information and Knowledge Services for resilience in 5 island countries in the Pacific Ocean: Cook Islands, Niue, Palau, RMI and Tuvalu.”

To identify existing research and initiatives pertaining to EWEA in Tuvalu, the study began with an extensive review of existing grey and published literature on disaster risk management (DRM), climate change and emergency management. While there are limited studies focused on EWEA at community level, however, the 2021 Tuvalu Drought DREF Operation (IFRC, 2021) ‘impending drought’ assessment provided valuable information with which to cross-check the recent impacts of drought, such as conditions in communities.

To understand the decision-making contexts in which EWEA takes place at the household-, community- and government levels, this study centred the ‘Values Rules Knowledge’ (VRK) framework in the research design process (Colloff *et al.*, 2018; Gorddard *et al.*, 2016). Interactions between contextually specific values, rules and knowledge frames decision options, constraining or enabling the adaptation processes (Gorddard *et al.*, 2016). This is helpful for understanding how certain decisions are developed, and how the decision-making context could be influenced to enable the imagining of new decision options. Taking a strengths-based approach, aimed at identifying existing resources, systems and structures that help support communities facing hazards, this research has sought to identify the triggers for local action along with gaps and areas for improvement.

Freshwater insecurity is noted as the top human vulnerability with livelihood impacts in the Tuvalu National Adaptation Programme of Action (NAPA), created by the Department of Environment in 2007 (UNDP Climate Change Adaptation Division, 2022). Climate change impacts which worsen the threat of cyclones, droughts, erosion, rising air and water temperatures, saltwater intrusion and storm surges continue to place pressure on Tuvalu’s hydrology and freshwater resources. The lack of consistent rainfall and adequate catchments for drinking water and other household, community and food security activities are negatively impacting the health and quality of life of many Tuvaluans.

These impacts are compounded by other hazards like cyclones. During the wet season (October–March), Tuvalu is particularly vulnerable to cyclones which can have severe impacts on local health, infrastructure and food and water security. Tuvalu is geographically quite vulnerable due to its physical characteristics and location, and its limited resources mean that the impacts of hazards are amplified in vulnerable communities. Ensuring the availability of sufficient freshwater is one of the key priorities for the Government of Tuvalu. Developing targeted early warning systems to trigger early action preparations for drought is paramount for strengthening the resilience of communities in Tuvalu to reduce the negative impacts of climate change.

Based on these preliminary findings, the overarching research question was framed around understanding existing community-level EWEA systems in Tuvalu, with a particular focus on droughts. A further exploration of hazards that are relevant for Tuvaluans has been completed

and is presented in Annex 3, in order to provide a starting point for future research. The interview guides used for data collection included questions that were focused on understanding the underlying values, rules and knowledge that influence and provide the trigger for Tuvaluans to take steps to prepare for the natural hazards they are affected by. The research questions were framed within a multi-hazard context in recognition that droughts often precede or follow other events, such as cyclones and storms.

The research questions covered the following areas:

1. Which early warning information and early warning systems (both formal and informal) are populations accessing (sources, types, frequency of information)?
2. To what extent are disaster-prone populations using the identified formal and informal early warning information and systems to make decisions and/or change behaviours at community, household- and individual-level?
3. What are the barriers and limitations to the existing early warning systems?
4. What existing pre-disaster behaviours occur at community-, household- and individual-level (both traditional practices and more recently initiated ones?)
5. What forms of support are needed to strengthen early warning systems and FbF including EWEA triggers and tailoring messages?

Data collection

Data collection for the study was led by national researchers, overseen by a senior researcher based at the University of the South Pacific in Suva, Fiji and supported by the National Societies of the IFRC and the Red Cross Red Crescent Climate Centre. The research used a mixed methods approach to investigate the above research questions, using a few research tools. The full toolbox with questionnaires, kobo survey guides and metadata collected can be found in the attached document.

- **Household questionnaire:** In total, 49 household interviews were conducted using a pre-designed questionnaire on Kobotoolbox. Surveys were conducted door to door using trained Tuvaluan volunteers and questions covered the following topics: household demographic information, socioeconomic status, hazards and impacts, actions and early warning systems.
- **Stakeholder consultations:** Eighteen critical stakeholders (9 female and 9 male) were interviewed from the following key EWEA agencies: the Tuvalu Red Cross Society (TRCS), Tuvalu Meteorological Service, National Disaster Management Office (NDMO) / Department of Disaster Management, Live & Learn Environmental Education, Public Works Department, Kaupule of Funafuti, and the Tuvalu Public Health Division.
- **Community focus group discussions (FGDs):** Thirty people – including men, women, children, elders and persons with disabilities – from three representative communities were invited for facilitated discussions to cross-check information from the household questionnaires and enable deeper discussion on the values and knowledge that often underpin action.

Data analysis

The data analysis for the report was done using the Value Rules Knowledge Framework (VRK)¹: The questionnaires for all methods were structured with the aim of understanding existing community-based preparedness and early action practices for disasters, with a particular focus on drought. They specifically addressed the categories of ‘values’, ‘rules’ and ‘knowledge’ by:

- Identifying some of the factors that contribute to local cultural decision-making contexts, thus shaping response capability, opportunities and constraints (**values**).
- Assessing key policies, guidelines and Standard Operating Protocols (SOPs) across the national, district, community and household levels (**rules**).
- Gathering information on the presence and efficacy of current early warning systems including communication networks and links (**knowledge**).

Once the data was collected, the team undertook a process of thematic coding to assess the understanding, processes and systems of EWEA for hazards among communities and stakeholders. The information was synthesized to account for the ways in which values systems, knowledge systems and rules inform EWEA processes for different groups. The research team held workshops to review the data and apply several thematic categories to the findings.

The following infographic outlines the methodological framework for VRK which was applied to the research in Tuvalu:

Figure 1. Value Rules Knowledge Framework in Tuvalu

¹ VRK is a framework for analysing the decision context, emphasizing that social and institutional issues, as well as knowledge and information, can enable or limit decision-making. Interactions among values, rules and knowledge both limit choices and define possibilities for change in the decision context.

Limitations

Below are three key method limitations:

The scope of the research: The GCF project covers five islands and selecting two countries for this research is an inherent limitation. Every country in the study has unique cultures, development trajectories, economic realities, physical environments, political systems and values. While there are certainly many shared characteristics among the countries, and they share regional governance structures (such as the Secretariat of the Pacific Regional Environment Programme (SPREP)), they are nonetheless highly unique. Therefore, it may be challenging to generalize research findings from specific islands. Nevertheless, the focus of this study has been to identify a replicable method for understanding the nexus of values, rules and knowledge that triggers EWEA. It aims to develop an approach that could be applied in other contexts as well.

Representativeness: Given the constraints of a two-month data collection window over the Christmas holiday period, coupled with the reality that it is only possible to visit the outer islands by boat, the Tuvalu research is limited to communities on Funafuti. However, the limitations of this approach were counterbalanced in two ways: first, communities were selected on Funafuti who had moved there from the outer islands and the team ensured that their responses also related to their experiences in the outer islands; second, we have triangulated information with raw data from the recent Tuvalu Drought DREF Operation (IFRC, 2021) ‘impending drought’ assessment, to tailor the questions in order to remove repetition and cross-check our findings. This previous survey was reviewed prior to conducting this research to identify early warning response gaps.

COVID-19 regulations: The inability to travel due to COVID-19 made this relatively short and community-focused research a challenge. In summary, not being able to travel resulted in delays in communication at all levels; training volunteers in data collection was not as efficient as it would have been had the research team conducted it in person after assessing local research needs, gaps and capacities; and delays in data collection along with local skills gaps for the analysis condensed the time available to compile the final report. However, there were also opportunities such as solely relying on in-country resources as well as the research being led and managed in-country, which allowed for a full interpretation of the local context.

Ethics and approvals

In Tuvalu there is no formal ethics or research approval process. Therefore, IFRC ethical processes were applied. IFRC and the Government of Tuvalu, through the National Drought Committee, were contacted for approval of the research.

The Red Cross has a Child Protection Policy and all researchers and volunteers have been trained accordingly and signed the policy. For the IFRC, the terms “youth” and “young people” cover all people in the age range of five to 30 years. This includes children (5–11 years old), adolescents (12–17 years old), and young adults (18–30 years old). In this study, all participants were above the age of 18, which is the legal age in Tuvalu to be interviewed without parental consent. All traditional and indigenous protocols were carefully followed throughout every phase of the research, with the needs of the communities at the foreground throughout.

A more detailed explanation on the research methods, limitations and lessons learned can be found in Annex 2.

Findings

Section 1: Setting the scene – the disaster and climate context in Tuvalu

This section provides a brief overview of Tuvalu's climate and disaster risk, and the institutional arrangements that frame climate change and disaster risk reduction (CCDRR) efforts.

Overview of climate and disaster risks

Tuvalu is part of Polynesia, located roughly 5,000 kilometres from Palau. It is made of nine atolls – Funafuti, Nanumaga, Nanumea, Niulakita, Niutao, Nui, Nukufetau, Nukulaelae and Vaitupu – that have an average height of less than three metres above sea level and a total surface area of 26 square kilometres. The highest point on the atolls is only five metres above sea level (Tuvalu National Strategic Action Plan for Climate Change and Disaster Risk Management 2012–2016, p.11). The population of Tuvalu is approximately 12,000 (World Population Prospects – Population Division – United Nations). Fishing activities make up 42 per cent of national revenue, with the remaining sources including passive income from its ownership of the internet domain name 'TV', the national trust fund, and remittances from migrants who have left the country (World Bank Group & Asian Development Bank, 2021b, p. 2).

A multi-hazard approach

The impacts of different hazards may coalesce and build off of each other (what climate modellers refer to as 'compounding or compound hazards'), such as concurring heatwaves and tropical cyclones (Matthews *et al.*, 2019, p. 602).

It is important to note that definitions of hazards, disasters and risk levels are subjective; the way in which a policy body defines disasters, hazards and risk levels may be different from the way that a community defines them, for example. In the article "Compound, Cascading, or Complex Disasters: What's in a Name?" hazards and vulnerability scholar Susan L. Cutter explores some of these complexities. 'Compounding' hazards are hazards that overlap with each other in the same timeframes and/or geographical location, interacting with and exacerbating each other.

Cutter observes that the process of identifying compounding events as primary, secondary and tertiary according to event temporality "has an inherent bias" and can "misleadingly prioritize the actual timing of the event over the damage or impact" (Cutter, 2018, p. 19). For this reason, comprehensive multi-hazard risk and impact assessments must seek to conceptualize and analyse hazards beyond the linearity of causal hazard chains (Cutter, 2018, p. 19). Consultation with impacted communities is essential to this process, including to highlight the role of social justice and traditional knowledge. This research has started the process of understanding how EWEA can support communities in Tuvalu experiencing multiple or cascading hazards.

As a result of its vulnerable geophysical position in the Pacific, Tuvalu is consistently identified internationally as one of the most climate-vulnerable states in the world (World Bank Group & Asian Development Bank, 2021b, p. 2). Tuvalu faces a range of climate-related hazards, including sea-level rise, soil and groundwater salinization, drought, heat stress, tropical cyclones and storm surges.

While tropical cyclones are listed as the highest-ranking hazard in Tuvalu, due to the economic impacts (World Bank Group, & Asian Development Bank 2021b), information from this research highlighted that households in Tuvalu felt comparatively better prepared for them, while they were most concerned about the impacts of drought on their families and livelihoods. In the past decade, Tuvalu has experienced two meteorological droughts. One occurred in 2011, primarily impacting Nukulaelae and Funafuti. The other occurred from January to June 2021, primarily impacting Funafuti, Nanumaga, Nanumea, Niutao, Nui Nukufetau and Vaitupu (EM-DAT: The International Disaster Database, 2021). The impacts of these droughts included significant water shortages and the loss of crops necessary for subsistence. During the drought in 2011, the government declared a state of emergency. The long-lasting vulnerabilities brought by droughts can make recovery from other compounding disasters like cyclones even more difficult (Ilese *et al.*, 2021, p. 19). Current climate models suggest that future drought events in Tuvalu are likely to fall more frequently into the category of 'extreme drought', rather than in the 'moderate' or 'severe' categories (Ilese *et al.*, 2021, p. 15). Based on the compounding impacts that cyclones are expected to have on droughts, and the lack of drought preparedness expressed by communities, the research also included questions to capture the compounding impacts.

Overview of governance structure

Key governing bodies

Figure 2. Organogram on disaster and climate governance in Tuvalu

The National Disaster Management Office (NDMO) is the key agency responsible for coordinating disaster management preparedness, response and recovery and plays a key role in supporting the work of the National Disaster Committee and maintains a detailed workplan covering a three-year period to 2023.

The National Disaster Committee (NDC) is the multi-agency advisory and coordination body for disaster mitigation, preparedness, response and recovery. Until 2021, the NDC has not had a clearly visible plan setting out its medium-term priorities for stronger disaster risk management. Through the NDMO the **National Disaster Preparedness Working Group (NDPWG)** is responsible for developing policy as well as training and awareness programmes aligned with the key DRM issues as determined by the NDC. **Island Disaster Committees (IDCs)** play a key role in coordinating and managing disaster risk on each of Tuvalu's nine islands. The **Government Advisory Committee** is the forum for discussion regarding the ongoing integration of DRM strategy into mainstream government business.

The **Department of Environment** has implemented several environmental programmes and projects. Each programme has established task committees or teams with representation from relevant and major government departments, non-governmental organizations (NGOs), religious bodies and stakeholders.

The Development Coordinating Committee (DCC) that was set up under the Office of the Prime Minister and is chaired by the Secretary to Government, assesses draft policies, projects and programmes prior to submission for approval by the Cabinet.

DRM coordination mechanisms

From 12 December 1997 a new form of governance was established for all island communities in Tuvalu. The new form of governance (Falekaupule Act of 1997), passed by the Parliament of Tuvalu, devolved the authority to the Falekaupule and Kaupule (two separate bodies) to work together in addressing community affairs to promote decentralization in order to decrease domestic urban drift. The Falekaupule is a fusion of traditional leadership with the introduced governing system. It functions as the decision-making body on the island. The Kaupule is the executive arm of the Falekaupule. The central Government links directly to the Kaupule as shown in figure 3. At the community level, Island Disaster Committees (IDCs) have been established to coordinate local activities and support communities' participation and leadership in disaster preparedness and response. IDCs conduct vulnerability assessments, create community action plans, provide training and share information with community members. Members of IDCs are mainly volunteers from the community.

Figure .: Tuvalu DRM coordination from Government to civil society. Source: Tuvalu National Strategic Action Plan for Climate Change and Disaster Risk Management 2012–2016, p.14

Section 2: Lay of the land – Policy and practice in Tuvalu

This section highlights relevant policies and funding arrangements pertinent to disaster management in Tuvalu to better understand the context in which implementing agencies operate.

Overview of key policies, plans and frameworks

This section provides a high-level snapshot of the key policies, plans and frameworks for DRM and emergency management in Tuvalu, which includes EWEA.



Figure 4. Key plans, policies and frameworks

Te Kete: Tuvalu National Strategy for Sustainable Development 2021–2030 outlines the Government of Tuvalu’s strategic priorities for “a peaceful, resilient and prosperous Tuvalu”. Several of the key strategic actions relate to improving EWEA. National Outcome 4, 1.4.4 notes the action of developing effective frameworks for disaster risk and resilience management. A key outcome of National Outcome 5 is to enhance meteorology services, and 1.5.3 notes the developing capacity to implement MHEWS. While EWEA will support the attainment of improved inclusion, improved health, access to education, resilient livelihoods, retaining and applying traditional knowledge, and so forth, National Outcome 17, 5.17.2, on developing and implementing a climate-proof national housing programme, 5.17.3, on establishing a sustainable maintenance programme, and National Outcome 20, on improving the quantity and quality of water, are some of the most targeted actions that can contribute to EWEA.

The National Strategic Action Plan for Climate Change and Disaster Risk Management (NSAP) 2012–2021 outlines national policies regarding DRM and EWEA in Tuvalu. The action plan lists improved communications for early warning systems as one of its goals, with an emphasis on increasing telecommunications with the outer islands to ensure that climate information and weather warnings are received early. Upgrading the capacity of the National Meteorological Service to include stations on the outer islands is identified as a key step in ensuring that accurate information circulates in a timely manner, with a focus on improving the experiences of end users. Additionally, the document includes plans to incorporate climate change and DRM into school curricula in order to cultivate a high level of risk awareness amongst school-aged children (Government of Tuvalu, 2011, p. 14).

Tuvalu Strategic Roadmap for Emergency Management (SREM) 2021–2023 fills an important gap in Tuvalu’s overall planning and coordination framework for DRM and emergency management. It presents a whole of country approach as well as a consolidated set of high-level and goal-oriented priorities to be overseen by the NDC over the next three years. The SREM provides an overall framework within which adjustments and updates will be made by the NDC for implementation through SREM Workplans. The SREM emphasizes the need for ongoing dialogue, collaborative planning and action involving all stakeholders across all sectors and levels. It represents and describes a commitment by the Government of Tuvalu to work together and collaborate on the planning and delivery of key disaster/emergency management priorities. The SREM is aligned with the overall strategic objectives of the **Pacific Islands**

Emergency Management Alliance (PIEMA) of which Tuvalu is a member. The PIEMA aims to build disaster management leadership, teamwork and trust as a basis for DRM in the Pacific.

The National Disaster Management Act (2008) enshrines in law the arrangements for disaster management and mandates. The National Disaster Management Arrangements (Parts 1–3) sets out the whole of Government approach to disaster preparedness and response.

The Water Resources Act 2020 helps ensure that water resources are governed effectively in Tuvalu so that necessary services can be provided to local communities.

While there is no national drought policy and the disaster management plans, frameworks, policies and SOPs are not all up to date, the Tuvalu SREM Goal 1 outlines plans to address these gaps.

Overview of EWEA stakeholders in Tuvalu

The following table shows identified national and international actors relevant for disaster management in Tuvalu. A more detailed table with the roles of these authorities is provided in Annex 1.

International	National
- Commonwealth Scientific and Industrial Research Organisation (CSIRO) - Pacific Meteorological Council (PMC) - Secretariat of the Pacific Regional Environment Programme (SPREP) - Pacific Community (SPC) - International Federation of Red Cross and Red Crescent Societies (IFRC) - Green Climate Fund (GCF) - United Nations Environment Programme (UNEP) - United Nations Development Programme (UNDP) - World Meteorological Organization (WMO) - Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) - Asian Development Bank (ADB) - World Bank (WB)	- Tuvalu National Disaster Management Office - Tuvalu Meteorological Service - Climate Change Department - Public Works Department - Disaster Relief Unit - Office of the Prime Minister Gender and Child Affairs - Live & Learn Environmental Education - Tuvalu Red Cross Society - Tuvalu Public Health Division - National Bank of Tuvalu - Tuvalu National Youth Council - Tuvalu National Council for Women - Tuvalu Fisheries Department - Tuvalu Department of Agriculture - Fusi Alofa Association Tuvalu - Tuvalu Media Corporation

Economy and impact of COVID-19

Tuvalu's economy is small, fragmented and highly vulnerable to external economic influences. This has led to a heavy reliance on outside development assistance and a degree of complacency in fiscal and financial management. The economy is unusual in the sense that a substantial amount of both Government revenues and private incomes are generated overseas. The Government revenue comes primarily from the income of the capital of the Tuvalu Trust Fund (TTF); assets of the 'dotTV' internet domain; fishing license fees paid by foreign fishing

vessels (natural resources); and sales of stamps and coins. For families, income is mainly derived from remittances for seamen (and other less formal remittances from Tuvaluan residents overseas). There are very little exports so semi-subsistence farming and fishing are the primary economic activities (NSAPCCDRM 2012, p.13). Fewer than 1,000 tourists, on average, visit Tuvalu annually and COVID-19 travel restrictions have impacted significantly on these numbers.

A 2021 report from a survey conducted (IOM/UN/ILO 2021) showed that the immediate state of emergency declared in March 2020 with the outbreak of COVID-19 had marginal impacts on Tuvalu as the Government responded quickly and closed its borders. The report also noted that the situation could deteriorate should the pandemic persist. This is primarily due to the principal employers being the Government and the private sector and due to Tuvalu's dependence on external supplies and remittances as noted above. The Government established a COVID-19 Taskforce and developed a blueprint for action (the *Talaaliki Plan*), passed a supplementary budget (31 per cent of GDP) and released an economic recovery package that received contributions from donors. Tropical Cyclone Tino had caused extensive damage to Tuvalu's islands in January 2020, compounding the subsequent effects of COVID-19. The tourism sector was widely affected, with significant disruptions to the transportation of essential goods including food, medicine, fuel and building materials (Bolstering Tuvalu's Socioeconomic Resilience in a COVID-19 World, 2021).

On 1 January 2016, the Government of Tuvalu established the Climate Change and Disaster Survival Fund Act – the Tuvalu Survival Fund (TSF). The TSF is intended to support both immediate disaster response efforts and longer term responses to future climate change impacts and natural disasters (Tuvalu: Climate Change and Disaster Survival Fund Act 2015). Little information can be found online as to what this fund has been used for to date; however, respondents in this research noted that they had been consulted about the TSF in the past but had not received updates. The GCF Programme will work with the TSF Board and Committee to enhance the functions of the existing Fund to ensure that Tuvalu's national climate services are adequately and sustainably financed. Tuvalu's three financial institutions are National Bank of Tuvalu, Tuvalu National Provident Fund and Development Bank of Tuvalu.

EWEA survey conducted
with an elderly person by
a Tuvalu Red Cross
Society volunteer in
January 2022
© Tuvalu Red Cross

Section 3: Summary of Findings

Sociodemographic information

Households

The 49 studied households were from five communities on Funafuti – the two traditional villages of Alapi and Senala and three communities (Fakaifou, Kavatoetoe and Lofeagai) that are mainly settled by people from the outer islands of Tuvalu. About 59.8 per cent of the participants were female, while 40.2 per cent were male. The ages of the participants ranged from 18–65 years old. About 98 per cent of the participants were Tuvaluans while 2 per cent were Samoans living and working in Tuvalu. Only 41.7 per cent of the participants interviewed headed the household. In Tuvalu, the head of household is usually the elder or “*matai*” (chief) of each family, not necessarily the income earner. There were many people living in each household studied. The average number of people in each household was 17.4 – about 8.9 female and 8.5 male – who were mostly adults. This high number of household members is due to the high movement of people from the outer islands to live in Funafuti to work and have better access to health and education services.

Land and house ownership

About 71.4 per cent of the studied households owned the land they were living on. About 26.5 per cent of households leased land or lived on government land. Only 2 per cent of participants were not sure of their land ownership status. In terms of ownership of the house they were living in, 76.9 per cent owned their houses; 12.2 per cent were renting; and 8.1 per cent did not know the ownership of the house they were living in. Land ownership and house ownership information is crucial so that households can make decisions to increase their water collection and water storage capacity – they can build houses and install more water collecting and storage capacity. About 98 per cent of households had houses with iron roofs that can be used to collect water.

Sources of income and expenditures

Although 42.9 per cent of households did not know or refused to disclose their total annual income, about 28.5 per cent of households earned less than 10,000 Australian dollars annually. About 16.3 per cent earned 10,000–20,000 Australian dollars a year and only 12.2 per cent earned more than 20,000 Australian dollars annually. The main sources of income for the studied households were full-time employment by the government (46 per cent), self-employed (own businesses) (22.2 per cent), full-time employment by NGO and the private sector (19.1 per cent), fishing and farming (6.4 per cent), and remittances (3.2 per cent). About 3.1 per cent of households interviewed did not have a source of income.

In terms of household expenditure, the common expenditures in a descending order were on: food, electricity/rent/other bills, education, church and island obligations, water, health and housing. Most of the households prioritized their daily needs such as food, rent and electricity or gas bills. Housing, water and health were important priorities as well but, due to limited income, households were not spending much money on them. As mentioned above, the total annual

income is low in Tuvalu and the cost of living is expensive as almost all food, construction materials and non-food items are imported.

Current household status

The study finds that households and communities in Tuvalu are surviving, not thriving. Households are keen to take action and prepare as they do not want their family to suffer. They are already doing what they can with the early warning information and resources available to them, and any other significant preparedness efforts will need considerable economic and technical support from the institutions. Keeping this background in mind, the findings from the study have been listed below:

- 1. Preparedness for hazards:** Cyclones are the hazard that people were most concerned about, but the hazard for which they were best prepared. The second hazard of concern was drought which, out of all hazards, they are least prepared for. Cyclones damage rainwater harvesting systems, often right before the onset of a drought and, therefore, compounding hazards are affecting households' ability to optimally collect water.

"Each cyclone does have an impact on droughts. However, cyclone can destroy certain things in the house which needs to be repair with an extra expense. For example, roofing gutter can be destroyed during cyclone. Roofing gutter it not able to be fixed overnight either in a community or household. That will be another lost while prepare for drought (and cyclone preparedness)". **Funafuti, Lofeagai and Kavatoetoe Women Group**

"Experience with this past cyclone, it stills a struggle to prepare for drought. There are limited resources to access to in order to support the lost or damages done by cyclone. Even from TC Tino some families or communities are still recovering from the damages done. Preparing for drought it a major challenge faced here in Tuvalu". **Funafuti Men Group**

- 2. Sources of water:** Water management decision-making in Tuvalu is a shared responsibility between men and women. Most of the households studied in Tuvalu (75.4 per cent) sourced water from their own water tanks (69.6 per cent) or water cistern (5.8 per cent). Only 10.2 per cent and 7.3 per cent of the households studied relied on community water sources and shared water tanks with neighbours respectively for their everyday water needs. Other households purchased water (7.3 per cent) from the private sector suppliers or government sources. For the households that purchased water as an everyday source of water, most of them spent around 10–30 Australian dollars per month which was reported as expensive for the households.

"Each house has water tank as their water supply and a community water cistern that can supply them with water. Usually, no, it does not support the family needs before even droughts occur as they always rely on the community water cistern. Not everyone has enough water storage or good roofing and etc.". **Lofeagai Men and Women Group**

3. Coping strategies for droughts: All households take action for drought; however, the actions were not sufficient to survive drought and, despite falling back on Kaupule community water resources, after two weeks households begin to suffer from the effects of a lack of fresh water.

“Everyone in the community suffered during these droughts”. Women and Men Group

Before the onset of a drought, households evaluated their water security level and invested in increasing their preparedness to reduce the impacts of droughts on their lives and livelihoods. About 71.4 per cent of the studied households repaired their water harvesting systems, including roofs and gutters; increased rainwater harvesting capacity by increasing roof sizes and water tanks; and exchanged thatched roofs for iron roofs. Households also reported that their savings were majorly consumed to purchase more water during droughts. Interestingly, about 2.3 per cent of the studied households had built new homes with underground water cisterns to increase water storage capacity. Other coping strategies to better prepare for droughts, as reported by the studied households, include planting drought-tolerant crops (7.1 per cent); raising drought-tolerant livestock (5.4 per cent); preserving food using traditional and modern methods (4.5 per cent); and increasing water storage capacity for the Island Council (Kaupule) (2.7 per cent). About 6.3 per cent of the studied households received water tanks as donations from the Government or NGOs; and two of the studied households reported that they already had sufficient water storage capacity with 3–4 water tanks, which they had installed after their experience of the 2011–2012 drought.

Box 1: Households who do not suffer from droughts

Of the 49 households interviewed, only two reported that they did not suffer during droughts. This was due to being in the high-income bracket, having access to loans, building new homes and, consequently, increasing water storage capacity to 3–4 10,000 litre water tanks and three cisterns (cement tank located under the home).

Water storage capacity at the household level is not sufficient during drought. Most households in the survey had one 10,000 litre water tank. With an average of eight people per household, one full 10,000 litre tank is not sufficient to support the household through a drought.

The commitment of the studied households to invest in reducing the impacts of drought is reflected in the sources of funds they use to do so. A majority of studied households (63.1 per cent) relied on their own savings, funds and remittances from relatives to purchase water tanks and carry out the drought preparedness strategies highlighted above. Interestingly, about 18.5 per cent of studied households said that they had access to financing and loans from banks to purchase tanks, rebuild their houses and increase their water storage capacity. However, these households were mostly those with higher monthly incomes since they were financially stable and could pay back their loans. But the households that did not have stable incomes or assets were unable to access these services. This finding points to a recommendation to provide support or subsidized loans for increasing the water harvesting and storage capacity of low-income households; Kaupule should be explored as an option for future projects as well as funding from the Government. The rest of the studied households relied on donations and charity, while some of those who did not have access to financial resources were prepared to ration and manage their limited available water during droughts.

Even though people prioritized investment in drought preparedness (71.4 per cent), given that they have experienced severe impacts regularly in the past, we find that their current actions and resources to adequately prepare are insufficient to protect them from future negative impacts.

4. Early warning Information: Almost half of the households were not receiving early warning information. Around 88 per cent of respondents identified the radio as their most preferred source of information. The few households that took early action in rationing water, reported that they had sufficient water during the drought. However, from the other actions people took, 33 per cent said it made no difference and only 6 per cent said it stopped the impacts altogether.

"People are more prepared for cyclone because of the better warning system than droughts. With cyclone the media announce it which the community follows it. But with drought that is general knowledge they observe it through their own understanding. Drought was never relied on for Meteorological advices".

Funafuti Men Group

When the studied households were asked about their experiences of early warning of the recent drought in Tuvalu, about 51 per cent confirmed receiving early warnings for the drought and 88 per cent preferred the radio as their source of information. This was due to the message being easy to understand, it coming directly from the most trusted source (Tuvalu Meteorological Service and the Drought Committee) and it being provided in both English and Tuvaluan. However, 42.9 per cent said they did not know about the early warning for the recent drought as they either did not hear it on the radio or did not own a radio. More female (32.7 per cent) participants answered 'yes' to receiving early warnings for the recent drought than male respondents (18.4 per cent). 28 per cent of respondents noted they received information from the internet.

"From previous experience, especially the 2011 drought, there is no warning or information about a drought. But traditional knowledge of understanding the weather pattern some community managed to identify the Drought from November 2010. By 2011 May when the warning was declared it is too late for some community to make preparation". **Lofeagai and Funafuti Women and Men Group.**

"Some communities have already taken action before the information was air through the radio".

Funafuti and Lofeagai Men Group

5. Traditional knowledge: Training workshops were the greatest source of knowledge on how to act during a drought. Traditional knowledge, including guidance from the Kaupule on water conservation and management practices during a drought, was also used by a quarter of the population to know how to act. However, there was minimal use of traditional knowledge for drought forecasting/ prediction. Information from public sources, including NDMO/national meteorological service/partners was similarly important for sharing knowledge of an impending drought; however, many people surveyed were not aware of climate predictions for drought. About 75.5 per cent of the studied households were also unaware of existing rules, orders or plans to manage drought.

"For more information on drought we just relied on traditional knowledge. While getting assistance by the Red Cross for any possibilities of relief items that can supply the community". Lofeagai, Funafuti and Kavatoetoe Women, Men and Youth Groups

"With traditional knowledge we were able to action and make preparation for the drought. Some man shared they have been fishermen all their life and looking and state where there is no fishing ground in the island (time period), gave them the idea of drought instead of strong wind warning. Some shared it was able to identified as the weather pattern that year just changed dramatically. If they compared with other years. It is a cyclone season and the weather pattern-remain humid dry". Funafuti Men Group

- 6. Community needs:** Most people preferred 'action' information as part of an early warning, and the call to conserve water was the most significant message to trigger action. This meant that respondents would prefer to be guided on what actions to take when a hazard is forecasted. People were reducing and conserving water when they heard the warnings; however, by then, some were already having to buy water.

"Implementing and upgrading of water resources for each community should take into action as nowadays drought can be frequently happening each year. Three to four dry spell per year that is a major hazards and disaster to the community especially for a healthy living". Funafuti and Lofeagai Women Groups

In the case of droughts, 52 per cent of respondents said that the advice to conserve water was the most useful information, coupled with advice on how to do it. However, warnings for drought are currently delivered when the country is already in, or responding to, drought conditions. Consequently, these warnings come too late for people to take any meaningful action. Add to that the lack of sufficient water tanks to prepare for drought results in many people being unprepared and unable to cope.

- 7. Leadership during hazards:** Decision-making did not sit with one person or group. For making decisions on managing water at the household level, 40.8 per cent of the participants who were interviewed during the household survey referred to themselves as the key decision-makers for water management – with more males (22.5 per cent) than females (18.4 per cent) assuming this responsibility. About 24.5 per cent of the participants reported that everyone in the household was responsible for decision-making to manage water; 22.5 per cent answered that it was the elders' responsibility; 10.2 per cent (mostly female) referred to their spouses (mostly male) as the main decision-makers on water management at the household level. Interestingly, 2 per cent of the participants identified "nobody" in the household was responsible making decisions on water management.

"For Funafuti the Kaupule makes decision in the community. For Lofeagai and Kavatoetoe there is disaster committee appointed to make decision for the community". Funafuti, Lofeagai and Kavatoetoe Men Group

"The decision-maker or chosen committee for community will be assisted by Public Work Department and Disaster team. They have been trained by the Disaster, Red Cross and PWD to make decisions for the community during hazard and disaster". Lofeagai Men Group

- 8. Health impacts:** Personal health and hygiene was deprioritized during dry periods. When household's water and sanitation systems fail, the environmental impact of droughts is severe on lagoon ecosystems as well as on the production of nutritious food from gardens and livestock.

"Well-being of the family as a mother perspective points of view. It is tough when drought occurs in the community. Understanding the use of water is limited and making sure that it is securely safe for food preparation". **Funafuti Women Group**

Section 4: Recommendations based on the findings

The findings of this study suggest that there are significant opportunities to build on existing good practices, with complementary strengthening of policies and operational practices, to enhance community outcomes in Tuvalu. The following section outlines a number of recommendations for consideration by implementing agencies.

- 1. Supporting increased water storage:** Households and communities need to have sufficient water storage capacity, which will likely require grants or micro-loans to achieve. For this, it will be crucial to increase the sources of, and access to, finances (government, banks, grants etc.) so that Tuvaluans can increase water harvesting and storage capacity at the household- and community-level. The first step involves identifying the requirement for tanks and cisterns for households to meet their needs during drought, considering the context of the outer islands as well as the household composition of the elderly, people with disabilities, infants, children, women and men.
- 2. Imparting knowledge and information:** It is recommended that information and knowledge is imparted to the communities on the following issues:
 - **Water management:** Information on best practices around water harvesting, optimum water recycling methods, self-monitoring of water levels, systems maintenance as well as information capture and sharing can enhance the ability of households to effectively manage water before and during droughts.
 - **Forecast information:** Early information on when rainfall is likely to occur and in what quantity is one area where households require more information. Additionally, news on when the drought will start and how long the drought may last is also critical. Information on drought stages, based on a worst-case scenario and the expectation of a phased response plan of actions as the drought progresses, would also help to enhance awareness and understanding. These can be strong messages for promoting preparedness and early action with a 'no regrets to action' approach. Best practice for building early resilience could be a key theme, as opposed to concerns that may be raised by discussing or encouraging a response to 'drought' or 'drought conditions.'
 - **Support services information:** Information regarding emergency contacts, rescue agencies and response programmes is often missing at the household level. This information can help households gain a sense of security.
- 3. Offering training:** Training opportunities, including the immediate repair of household water systems, are required by the communities. Such training should be targeted at women and men separately and offered at times when they are available. Given that women were mainly found to be responsible for managing domestic water use within the households, and felt least prepared for droughts, they would benefit from training on sustainable water management practices. Whereas men who felt least prepared for cyclones would benefit from training that imparts skills on strengthening roofs for strong winds, building temporary embankments to prevent tidal surges and so on. Additionally, materials and training support is also required for drought committee members to deliver information to the households in their community.

- 4. Expanding early warning networks:** It is recommended to use multiple channels to reach women and men with early warnings on impending drought, including information on a range of water conservation actions such as recycling water. These warnings need to be sensitive to raising expectations or fear. They must be well-managed, based on national Early Action Rainfall (EAR) Watch (EARWatch) along with drought information from the national meteorological service, and shared in a timely, intentional and clear way. The radio is currently the preferred method for receiving warnings. With improved internet access, social media, updated website information and direct messages from trusted sources could also be beneficial. Additionally, opportunities may exist with telecoms companies in the future, as has happened elsewhere in the Pacific (e.g., Fiji, Vanuatu), depending on resourcing and accessibility, with technological advances in satellite internet systems providing future opportunities to reach people in the most remote areas.
- 5. Investing in Water, Sanitation and Hygiene (WASH):** The findings showed the health impacts – especially on women and children – caused by the unsanitary conditions from declining water availability. This requires investment in a programme for WASH activities for early action, potentially by building water reserves for priority groups in community areas, which can be activated/opened for use every time a drought warning is triggered.
- 6. Ensuring future programmes are gender sensitive:** Given the differences in impacts faced by men and women, it is important to ensure that targeted consultations and workshops on climate change predictions for Tuvalu along with drought management plans, policies and SOPs are delivered to both men and women (not just drought committee members) at times they are available to attend.

In addition, here are a few recommendations for policy-makers, researchers and EWEA actors:

Recommendations for policy-makers

- **Defining hazard terminologies:** The importance of linguistic clarity and shared terminology became apparent as questions were discussed with local facilitators to ensure that the meaning and intent of the questions were clear. For example, terms such as ‘droughts’ and ‘dry spells’ are currently being used by different actors to refer to events of varying durations and severity. For these reasons, we recommend that all policy documents and initiatives pertaining to EWEA clearly define the terms in locally understood language to ensure shared understanding. Our findings indicate that this is not merely a semantic issue; the process of hazard conceptualization shapes behaviours, defining the parameters for EWEA triggers.
- **Incorporating a climate lens into policy-making:** Information on climate change-related hazard risks in Tuvalu should become part of future policy-making, and all sectors should be engaged in combatting the long-term impacts of accelerated anthropogenic climate change. For example, infrastructure developments should be planned around predicted climate risks to be able to withstand intensifying hazards. Going beyond the sector of disaster management, planning for a long-term strategy on climate action should involve multiple stakeholders, including the private sector.

Recommendations for researchers

- **Using a differential vulnerability lens for studying a range of impacts:** At the research level, EWEA is a rich and multifaceted topic. This project has served in many ways as a thematic scoping exercise. We have found that factors such as gender, age, education, and socioeconomic status are all likely to impact the ways in which EWEA is experienced. Further studies providing in-depth analysis of these intersections would represent a valuable addition to the literature.
- **Using a similar study approach to explore other hazards:** There is also considerable scope for future studies on EWEA in relation to other key hazards. The approach that we adopted in this study (in-depth analysis in each country of a singular hazard's impacts) could be used to conduct future work on different hazards impacting Tuvalu.
- **Incorporating cultural/local contexts into study design:** Our study suggests that qualitative research is of great value to scholarship on EWEA as a whole. This project found that the efficacy of EWEA is significantly informed by dynamic social factors such as values and cultural norms, and qualitative research may help to provide valuable insights on these less physically tangible themes that underpin why people take action. Attention to the culturally and contextually specific social and epistemic factors that shape EWEA will help practitioners tailor their approach to be as effective as possible.

Recommendations for local EWEA actors

- **Developing of roster of interested EWEA actors:** A major strength identified throughout this project is the number of agencies and organizations in both countries tasked with promoting the interests of vulnerable groups. Tuvalu has several locally led NGOs and government agencies devoted specifically to gender equity, disability inclusion and youth. Many of these groups are already working to advocate for the needs of their target populations via DRR initiatives, suggesting that there is considerable enthusiasm for further EWEA development based on the needs of marginalized groups. Any EWEA operations undertaken in Tuvalu will benefit greatly from consultations with these specialist groups at all stages, as well as established community governance structures, as they have access to unique knowledge and lived experiences. Therefore, building on the stakeholder mapping done in this study, we recommend a roster of active and/or interested EWEA actors in order to communicate, harmonize efforts and share learnings.
- **Forming an integrated platform/working group:** In a similar vein, the efficacy of the stakeholder consultations conducted suggests that platforms for inter-agency knowledge exchange are of considerable benefit to EWEA actors in the region. EWEA systems are highly interdisciplinary in nature, and organizations working in all sectors have a role to play in promoting effective EWEA. Regular meetings and platforms provide an opportunity for actors to brainstorm together, share their ideas and identify gaps as well as areas of repetition or overlap (as the stakeholders in Tuvalu did during our consultations). Opportunities for regular validation and feedback sessions on EWEA between local community members and the stakeholders that serve them, ideally conducted in the communities themselves, are also likely to be of benefit in future work. Further, sharing reports and other information in formats that are tailored to the group would provide valuable insight and opportunities to grow collective knowledge and understanding.

Conclusion

Tuvaluans have faced the impacts of droughts and other hazards for years, leading to widespread socioeconomic decline. To support island communities in coping and adapting to climate shocks, it is important to understand the local rules and values that shape people's behaviours. In conclusion, we provide a table of the key findings from this study under the headings 'Rules', 'Action', 'Knowledge' and 'Values' as a direction for the different stakeholders interested in using evidence from this study to shape future programmes.

Table showing key findings and opportunities on EWEA in Tuvalu, in line with the VRK Framework

Findings	Opportunities
Rules	▪ Update all DRM and EWEA plans as recommended in the SREM. ▪ Strengthen community water access management plans to include household-level interventions and well-understood SOPs during periods of drought and non-drought. ▪ Identify needs and requirements for tanks and cisterns for households to meet their drought requirements in Tuvalu and include tank storage requirements in the Building Act. This must consider the context of the outer islands as well as household composition of elderly, people with disabilities, infants, children, women and men.
Action	▪ Ensure early warning messages reach both women and men on impending or potential drought conditions and includes information on a range of water conservation actions, such as recycling water. These messages need to be sensitive to raising expectations or fear. They must also be well-managed and based on national EARWatch, for example, as well as drought information from the national meteorological service. The messaging needs to be shared in a timely, intentional and clear way in both English and Tuvaluan. ▪ Training opportunities must be targeted for women and men to reach people at times when they are available. Programmes need to be delivered to reach women and men as separate target groups as women are responsible for managing domestic water use within the household and felt least prepared for drought, whereas men felt least prepared for cyclones. ▪ Decision-making is not dominated by one group or another – this gives great opportunities for different groups to be further empowered to take on different roles around sharing and gathering information as well as developing community early action plans. ▪ Information on when the drought will start and how long the drought may last is also critical. Information on drought stages, based on a worst-case scenario and the expectation of a phased response plan of actions as the drought progresses, would be useful. These can be strong messages for preparedness and early action with a 'no regrets to action' approach. Best practice for building early resilience can be the theme, as opposed to concerns that may be raised by discussing the response to 'drought' or 'drought conditions.' ▪ Strengthen household-level water management through the procurement of sufficient tanks as well as equipment to monitor tank water levels, and ensure sustainable maintenance. In addition, households can be trained to identify low water tank levels and how different levels trigger action without needing to wait from directives from other sources. ▪ Improve water management and maintenance as well as water use efficiency, including recycling skills to enhance the ability of households to effectively manage water during droughts. ▪ Increase community water storage capability and maintenance along with skills in water monitoring and management as a back-up source during droughts. ▪ Consider increasing households' access to finances (government, banks, grants etc.) to increase water harvesting and storage capacity at household- and community-level.

**Knowledge
(including
traditional
Knowledge)**

- Ensure targeted consultations and workshops on climate change predictions for Tuvalu, drought management plans, policies, SOPs and fines are delivered to both men and women (not just drought committee members) at times when they are available to attend.
 - Materials, training and support are needed for drought committee members to deliver information to the households in their community.
 - Look for linkages to combine existing traditional knowledge with forecasting models and information.
 - Develop targeted programmes for women and men to receive earlier warnings on impending drought. The radio is currently the preferred method for receiving warnings. With improved internet access, social media, updated website information and direct messages from trusted sources could also be beneficial. Additionally, opportunities may exist with telecoms companies in the future, as has happened elsewhere in the Pacific (e.g., Fiji, Vanuatu), depending on resourcing and accessibility, with more technological advances in satellite internet systems providing future opportunities to reach people in the most remote areas.
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Values

- Expand individual, household and community skills and knowledge about what can be done, what resources are required and what simple measures can be taken, while recognizing and acknowledging where actions are already being taken. Empower communities to have different roles and skills where there are known gaps (e.g., in water management, monitoring, systems maintenance as well as information capture and sharing).
 - Households have exhausted their current resource options and have limited additional ability to act. The most effective actions such as water rationing, awareness and information on when and how to act need to be prioritized together with identifying funding opportunities to improve household-level water storage capacity and maintenance.
 - Invest in a programme of ongoing WASH activities for early action.
 - Invest in raising awareness of the impact of drought on the lagoon ecosystem and improving water recycling to meet the needs of gardens/livestock.
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Annex 1: Tuvalu drought stakeholders

Stakeholder	Sector	Key roles
National Disaster Management Office (NDMO)	Government	Plans and develops SOPs for droughts, including disaster legislation, policies and management. Manages drought and chairs the Tuvalu Drought Committee
Public Works Department (PWD)	Government	Supplies water, assesses water capacity, rations water, and distributes water during droughts. Carries out drought assessments and responses, and enforces building codes
Tuvalu Meteorological Service	Government	Delivers early warnings for hazards, provides forecasts and climate services
Tuvalu Media Corporation	Government	Communicates drought warnings and information
Climate Change Unit	Government	Implements climate change adaptation initiatives and water projects
Climate Change Project	Government	Implements National Adaptation Plan, coordinates NDC
Department of Agriculture	Government	Assesses impacts of droughts on agriculture and intervenes to reduce the impacts of droughts on agriculture and food security
Fisheries Department	Government	Utilizes early warning systems
Tuvalu Red Cross Society	NGO	Delivers disaster planning, warnings, assessment and management
Fusi Alofa Association Tuvalu	NGO	Promotes the interests of people living with disabilities in Tuvalu
Tuvalu Council of Women	NGO	Promotes the interests of women in Tuvalu
Live & Learn Environmental Education	INGO	Education initiative focused on the preservation of community livelihoods, including water security
Tuvalu National Youth Council	NGO	Promotes the interests of young people in Tuvalu
World Bank (WB)	INGO	Implements climate and disaster resilience projects, including water projects
Asian Development Bank (ADB)	INGO	Implements climate and disaster resilience projects
Funafuti Island Council	Local government	Promotes the welfare of Funafuti communities and implements community-based projects
Kiatoa	Private sector	Sells water and filtration systems
National Bank of Tuvalu/ Development Bank	Business sector	Potential provider of insurance and loans to improve water storage capacity
University of the South Pacific	Educational institution	Conducts research and helps to develop EWEA capacity building strategies
Secretariat of the Pacific Regional Environment Programme (SPREP)	Regional organization	Pacific Meteorological Council of SPREP provides water services, meteorological services and development projects in Tuvalu
Pacific Community (SPC)	Regional organization	Implements water projects and provides technical support for droughts to the NDMO

Annex 2: Detailed research methodology

This study used a mixed-methods approach. First, a desktop literature review was conducted. This review was followed by household surveys, semi-structured focus group discussions with community members, and a group consultation with relevant stakeholders (local policy actors and service providers) including a validation session.

Method 1: Literature review

To identify existing research and initiatives pertaining to EWEA projects in Tuvalu, the study began with a review of existing literature. The review identified:

- different types of disasters that affect Tuvalu and their impacts, along with future hazard projections in the face of climate change
- key hazard management stakeholders and the scope of their work
- existing approaches to EWEA in Tuvalu
- information gaps on EWEA to inform the content of the data collection tools.

Further, IFRC and Tuvalu Red Cross Society conducted early action research for the extended period of drought in 2021 using the internal Red Cross Disaster Response Emergency Fund (DREF), which included household surveys across all northern islands of Tuvalu and Funafuti on current water access, use and availability. The EWEA research team was able to review some of the raw data to cross-check the types of questions asked to ensure there was no repetition and review some of the early data/findings to compare any strong themes. While a full analysis and cross-checking of these two datasets (this research and the DREF-funded data collection) is beyond the scope of this project, it is recommended that DREF survey results are reviewed when available to inform the GCF project planning phase.

Method 2: Household survey

A household survey was conducted in five communities on Funafuti Island, where about 60 per cent of the ~11,000 people in Tuvalu live. The household survey guide can be found in the attached document titled Tuvalu Research Tools.

The survey asked closed-ended questions to gather quantitative information. Surveys were conducted door to door and questions covered the following topics: household demographic information, socioeconomic status, water use and management, historical information, actions and early warning systems. The survey sought to gain information on:

- socioeconomic status of households
- which climate hazards have the greatest impacts on households
- historical timelines of hazards and the impacts of compounding hazards
- impacts of droughts on the households, with a focus on drought-related losses

- warning systems and processes for droughts, with a focus on triggers
- actions taken to reduce drought-related risk and vulnerability
- values, rules and knowledge informing decision-making processes at the household level
- lessons from previous water projects targeting drought.

Five communities from Funafuti were selected to participate in this portion of the study. These included two traditional villages, Alapi and Senala. These two villages are administered by the Funafuti Island Council, which is the governing body responsible for making decisions on their development, resilience and welfare. The other three communities were Kavatoetoe, Lofeagai, Fakaifou. These communities are occupied primarily by Tuvaluans from the outer islands and were selected to represent households from outside Funafuti.

Community	Total number of households	Number of HHs to interview	%
Alapi	1024	100	9.8
Senala	589	50	8.5
Lofeagai	399	40	10
Kavatoetoe	343	34	9.9
Fakaifou	1007	100	9.9
Total	3362	324	9.6

The table above shows the breakdown of the total population of the five communities and sampling for household interviews, which were conducted via a KoBotoolbox survey. The number of households selected to participate was mainly based on the following logistical parameters: the research timeline for the interviews and number of volunteers available to complete the interviews in time. The household selection process was based on the availability of household members to be interviewed. Together with availability and consent, factors such as social roles, age, gender and household size were used to guide the sample selection of households. A stratified sampling method was also used to ensure that the households selected were as representative as possible.

The head of the household or his/her nominee was targeted as a key participant to answer the household questionnaire because they were likely to be critical in making household-level decisions regarding EWEA. They were also likely to be a reliable source of information on household socioeconomic information, drought impacts and water security.

Method 3: Focus Group Discussions (FGD)

Three focus group discussions – one male, one female and one youth – with participants from three different communities, were conducted in Funafuti. The FGD guide can be found in the attached document titled Tuvalu Research Tools.

The number and gender of participants are noted below:

1 × Male FGD 10 males

Funafuti Men – 6 participants

Lofeagai Men – 3 participants

Kavatoetoe Men – 1 participant

1 × Female FGD 10 females

Funafuti Women – 3 participants

Lofeagai Women – 5 participants

Kavatoetoe Women – 2 participants

1 × Youth FGD 10 youths: (8 males, 2 females)

Funafuti Youth – 4 male participants

Lofeagai Youth – 2 male and 2 female participants

Kavatoetoe Youth – 2 male participants

FGDs were carried out at the University of the South Pacific, Tuvalu Campus. Ten community members representing a diversity of households were selected to participate in each FGD. These community members were selected through a range of village committees and groups, including the Island Development Committee, the Women's Committee, the Youth Committee and local groups for people living with disabilities. The Tuvalu Red Cross Society selected FGD participants. The FGDs were facilitated by Tuvalu Red Cross Society volunteers. The male FGD had one male facilitator, the female and youth FGDs had one female facilitator each. Each group had a notetaker. The facilitator asked the questions while the other volunteer wrote down group responses on a large piece of paper so that the entire group could see them. Where consent was given, discussions were audio recorded via mobile phone and then transcribed, translated and analysed for the report.

The FGD guide included the following elements:

- A timeline of hazards faced by each community over the past decade, including specific hazards, EWEA processes for each hazard and its impacts. During the discussion, these were mapped in a table showing the name of the hazard/disaster, its start and end date, its impacts (direct, cascading and compound) and the EWEA that were taken in response to the hazard.
- Details of the EWEA process for drought as follows:
 - early warning – types of information that circulate (including traditional knowledge), sources of information, communication methods and effectiveness of the warnings in inciting early action

- early action – types of actions taken at specific times, capacity of interviewees to act, effectiveness of the action in reducing risk and community understanding of triggers for EWEA.
- Gender roles and considerations that impact current EWEA systems.
- Values, rules and knowledge implicated in decision-making processes and contexts.
- Ways forward and areas for further development relating to information, timing, language, efficiency and effectiveness of warnings at both the household and community levels.

Additionally, in the village of Lofeagai, the project assessed the efficacy of a specific 2009 initiative: the Secretariat of the Pacific Regional Environment Programme's (SPREP) Pacific Adaptation to Climate Change (PACC) water project. PACC sought to demonstrate best practice adaptation strategies in three climate-sensitive areas: coastal zone management, food security and production, and water resource management. In Tuvalu, the focus of the country project was climate-proofing water management plans for the community of Lofeagai. Building on the qualitative data obtained through the household interviews, FGDs and stakeholder consultation, the research assessed whether or not the management plans were successful and if management has changed over time. We asked the following questions: if the facilities are still in use and maintained, were they successful at mitigating the impacts of drought by securing sufficient potable water and meeting other freshwater needs? How sustainable have the interventions been in the long run? Has this project strengthened EW and EA outcomes at the community level; and, if so, how? Finally, what have the community and the government learned from this project?

Stakeholder consultations:

Stakeholders who were members of the Tuvalu Drought Committee were interviewed in a group consultation. Eighteen participants (9 female, 9 male) attended from the following Committee members:

Red Cross – 6 (3 female, 3 male)
 National meteorological service – 1 (1 female)
 NDMO/ DDM – 6 (3 female, 3 male)
 Live & Learn – 2 (2 female)
 PWD – 1 (1 male)
 Kaupule of Funafuti – 1 (1 female)
 Public Health Division – 1 (1 male)

The questionnaire for the stakeholder consultation covered:

- roles of Committee stakeholders in drought EWEA initiatives, with a focus on decision-making processes for EWEA
- roles of the stakeholders in addressing water security generally in Tuvalu
- lists of ongoing water security projects

- values, rules and knowledge that inform the roles of the stakeholders, including how information is communicated
- upcoming developments, including the impacts of COVID-19 on capacity and service provision.

The stakeholder consultation occurred over the course of a day-long workshop co-facilitated by the USP Tuvalu Campus and the Tuvalu Red Cross Society. The workshop was divided into two half-day sessions. The first session was a guided group discussion among representatives from the list above. This session was an opportunity for stakeholders to collectively share and verify information on their roles pertaining to multi hazards, drought and EWEA. It also enabled the stakeholders to obtain feedback from each other on the services they currently provide and the information they need to guide EWEA decision-making. This allowed them to identify points to strengthen for early action communication across agencies and sectors. Each participant was asked if they were willing to give their informed consent via a signed form prior to the start of the consultation session, including their consent for the session to be audio recorded.

During the second session, preliminary findings from the household questionnaire and community FGDs were shared. The aim of the second session was to validate the information collected from the communities. The larger group provided comments, feedback and suggested actions for strengthening EWEA systems for drought and other hazards in Tuvalu.

Data synthesis

The questionnaires for all methods were structured with the aim of understanding existing community-based preparedness and early action practices for disasters, with a particular focus on drought and the impact of cascading hazards. They specifically addressed the categories of ‘values’, ‘rules’ and ‘knowledge’ by:

- gathering information on the presence and efficacy of current early warning systems, including communication networks and links (knowledge)
- identifying some of the factors that contribute to local cultural decision-making contexts, thus shaping response capability, opportunities and constraints (values)
- assessing key policies, guidelines and SOPs across the national, district, community and household levels (rules).

Data from the household questionnaire was formatted using the KoBotoolbox App on electronic tablets and Android phones for ease of data collection. Volunteers from the Tuvalu Red Cross Society visited the households and administered the questions. Volunteer data collectors worked in teams of two – with one male and one female where possible – to collect data from available households. One volunteer explained the context of the study and asked the participants the questions, while the other recorded answers and took notes. Volunteers alternated these roles throughout the study to ensure an equal gender distribution of roles. A hard copy of the KoBo-formatted questionnaire was used during the interviews. After the interviews were complete, all scripts were checked by the data manager to ensure the information had been gathered consistently. The data manager reviewed all interview responses before the information was entered into the KoBotoolbox App. All data from households was then transformed using the ‘Report’ function of KoBotoolbox and uploaded to Microsoft Excel

for analysis. Basic descriptive statistics of quantitative data were conducted. Common themes and key trends were tabulated for the report. All data was disaggregated based on gender and household income levels.

For the FGDs and stakeholder consultations and validation, interview guides were used as a foundation for semi-structured data collection. Participatory research methods such as hazard timelines, concept maps to identify resource locations, information flow and decision-trees and SWOT (Strength, Weakness, Opportunity and Threat) analysis were included. These participatory methods helped to identify existing strengths within EWEA projects: how information flows from national to local level, how decisions are made at each level, and how this overall process culminates in a response.

All FGD and stakeholder consultation scripts, tables and concept maps were manually transcribed and translated into English by the local researchers and further analysed with the rest of the research team. A thematic analysis of the FGD and stakeholder consultation data was conducted to assess the understanding, processes and systems of EWEA for hazards among communities and stakeholders. The information was synthesized to account for the ways in which values systems, knowledge systems and rules inform EWEA processes for different groups.

Training of data collectors and facilitators

Volunteers from the Tuvalu Red Cross Society are locally trained specialist data collectors and were selected for this research based on the following criteria:

- recent experience conducting community-based surveys using gender-sensitive approaches
- competency in using the KoBotoolbox App to collect data
- familiarity with the location of the communities and households.

The Red Cross volunteers were coordinated by a Team Leader who was responsible for developing the data collection logistics as well as coordinating with all national stakeholders. The volunteers for this project were trained by the USP team specifically on the protocols for administering the research tools.

For the data collectors conducting household surveys, the training covered:

- the selection of households, acquiring and signing consent forms, interview processes, the intention of each question, and use of KoBotoolbox
- Guidance on audio recording and notetaking
- The process of maintaining confidentiality and the coding of households to preserve the anonymity of participants.

For the facilitators leading FGDs, the training covered:

- the selection of community participants, acquiring and signing consent forms, the facilitation process, and the intention of each question
- guidance on discussion facilitation, active listening, audio recording and notetaking
- systems for maintaining confidentiality and the coding of households to preserve the anonymity of participants
- transcribing and translating interviews for analysis.

This research is subject to several limitations which fall into two main categories: methodological limitations and limitations related to issues with the researcher(s).

Methodological limitations

The scope of the research being only two of the five islands included in the GCF project is an inherent limitation. Each country in the study has unique cultures, values, physical environments, development trajectories, political systems and economic realities. While there are certainly many shared characteristics among the countries, and they share some regional governance structures (such as SPREP), they are nonetheless highly unique. Therefore, it may be challenging to generalize research findings from specific islands. For this reason, the focus of this study is identifying a replicable method for understanding the nexus of values, rules and knowledge that triggers EWEA. It aims to develop an approach that could be applied in other contexts as well.

Given the constraints of a two-month data collection window, coupled with the fact that it is only possible to visit the outer islands by boat, the Tuvalu research is limited to communities on Funafuti. The limitations of this approach are counterbalanced in two ways: firstly, communities have been selected on Funafuti who have moved there from the outer islands. We will ensure that the content of their responses is related to their experiences in the outer islands. Secondly, we have triangulated information with the outcomes of the recent Red Cross data survey in 2020 to cross-check the findings. This previous survey was reviewed prior to conducting this research to identify early warning response gaps.

Time constraints meant not being able to research EWEA preparedness in the same depth for all of the hazards facing Tuvalu. For these reasons, the research was predominantly focused on droughts. However, we also asked interviewees in both countries to self-identify the hazards that most impact them and their communities. If the findings of the research identify a need to independently explore EWEA for other hazards, then we will need a second phase of research to cover those additional hazards in-depth.

Limited access to data was a constraint as there was limited published or grey literature on EWS or EA in Tuvalu. There was similarly little scholarship on gendered considerations related specifically to EWEA, disability inclusion in EWEA, or research on other vulnerable groups and EWEA in Tuvalu. Therefore, the research was developed based on previous work on hazard impacts and climate change more generally in Tuvalu.

COVID-19 regulations and the inability to travel made this relatively short and community-focused research a challenging endeavour with two main impacts:

- i. The inability to travel meant the research had to rely solely on in-country resources. There were time delays and communication challenges with local stakeholders and research team leads. More lead-in time is required for remote research as other work priorities and commitments hampered planning at all levels of local engagement. In Tuvalu, the best way to engage and make arrangements is in person at the appropriate level, rather than remote communication modalities often by junior stakeholders, and the time needed to arrange meetings and make arrangements was extended. Similarly, it was challenging to train local staff on research of this complexity, including to be certain that the intent of questions was understood, and the expected approach was taken. While the local researchers were experienced in conducting household level surveys, a key limitation was their capability to conduct academically rigorous research. Capacity building is required to ensure they can facilitate FGDs, take notes, interpret feedback, ask alternative questions to draw out linkages and cross-check information, together with capturing findings and undertaking analysis.
- ii. Planning and coordinating among the lead research team members took significant time and effort. Not being able to work together in person caused delays throughout the process due to time zone differences. Communication between different parties often took place via email chains, and often with key members in the field conducting other research or fitting meetings in between COP26 engagements. Despite these challenges, the team made the most of virtual communications with regular weekly and, at times, twice-weekly meetings to reduce turnaround times. Given that the research was commissioned by the Netherlands-based Red Cross Red Crescent Climate Centre, coordinated by the Vanuatu-based Pacific IFRC DRR Coordinator in partnership with the Fiji-based USP PaCE-SD Research Fellow, supported by a New Zealand-based research consultant, and a United Kingdom-based Climate Centre Junior Researcher at Oxford University, with the research physically conducted in Palau and Tuvalu, it has taken cooperation, partnership and commitment to produce this critical piece of research.

However, there were also opportunities posed by COVID-19 such as solely relying on in-country resources with the research being led and managed in-country.

Researcher limitations

Bias and translation errors are limitations of most research. Questions were thoughtfully developed with the intention of understanding the factors that facilitate or impede early action for hazard response. To minimize bias and leading questions, a mixed-methods approach was taken. Individuals could answer with anonymity while groups could discuss their experiences with local researchers using a culturally appropriate approach and language. While we were able to collect and collate the questionnaire survey data using KoBotoolbox, meaning that answers could be ranked or scored to facilitate the compilation of scaled results, the FGD and stakeholder consultation data was collected and transcribed by hand and later translated into English by the USP research team. The hand-written survey data was screened by the Team Leader for quality control before the data was uploaded into KoBotoolbox. In Palau, the use of online survey methods meant that the team could not perform quality control assessments prior to data submission. The survey format also meant that the nuances of more complex qualitative questions could not be probed further during the data collection phase. However, the direct submission of

data by interviewees also eliminated the need for any hand-written data collection or interpretive notes. Eliminating this middle stage decreased opportunities for bias or translation errors.

Differences in personal bias due to beliefs, customs, attitudes and culture have been partially minimized as the study has been conducted by Tuvaluans trained in data collection. Furthermore, in Tuvalu the information gathered has been triangulated by community members and national stakeholders themselves, with the final outcomes of all three research methods verified at the EWEA verification workshop.

Limited access to key informants and even to the research team was also an issue given the short timeframe for the research study. Data collection occurred in January, which is typically a period during which people travel home and organizations close for the holiday season in the Pacific. Furthermore, several hazards occurred in the Pacific during the research timeframe. These included storm surges, cyclones and the January 2022 Hunga Tonga-Hunga Ha'apai volcanic eruption. These hazards caused delays for team members living in impacted areas or working to deliver support to impacted areas.

Annex 3: Tuvalu hazard types and projections

Tuvalu faces a range of climate-related hazards, including sea-level rise, soil and groundwater salinization, drought, heat stress, tropical cyclones and storm surges. Some of their impacts as observed in Tuvalu are briefly outlined below.

Sea level rise is a major concern in Tuvalu based on literature. Given that all the atolls are quite close to sea level already, sea level rise will have significant impacts on the island's inhabitants and ecological make-up. Ground water salinization is of particular concern; Tuvalu is already almost entirely dependent on rainwater as a water source, and sea level rise is likely to increase rates of salinization on farmland. It also heightens the risk of contamination of freshwater supplies due to saline intrusion, and increased damage to infrastructure during severe storms (World Bank Group & Asian Development Bank, 2021b, p. 10). Issues with saltwater inundation on Tuvalu are compounded by the fact that much of the atoll's surface was disturbed during World War II military construction projects, causing an increased risk of saline seepage in the present day (Government of Tuvalu, 2011, p. 6).

Drought is a key concern in Tuvalu. Drought is a slow-onset disaster and is sometimes described as a 'creeping disaster' because often the impacts are already acute by the time a drought is identified (Ilese *et al.*, 2021, p. 18). Drought is not a new phenomenon in Pacific Island Countries; there are accounts of pre-colonial droughts leading to famine, and accounts of drought by early European colonists in the region. However, the lack of hydroclimatic records spanning more than a century back makes it difficult to quantify the extent and severity of historical droughts in the region (Ilese *et al.*, 2021, p. 18). In the past decade, Tuvalu has experienced two meteorological droughts. One occurred in 2011, primarily impacting Nukulaelae and Funafuti. The other occurred from January to June 2021, primarily impacting Funafuti, Nanumaga, Nanumea, Niutao, Nui, Nukufetau and Vaitupu (EM-DAT: The International Disaster Database, 2021). The impacts of these droughts included significant water shortages and the loss of crops necessary for subsistence. During the drought in 2011, the Government declared a state of emergency. At that time, 61 per cent of households on some islands were solely dependent upon brackish well water for bathing, laundry and flushing toilets (Ilese *et al.*, 2021, p. 18). Furthermore, there is evidence that both the pre-onset and termination periods of droughts correlate with the presence of cyclones in the South Central–Western Pacific. The enduring vulnerabilities wrought by droughts can make cyclone recovery even more difficult in these instances (Ilese *et al.*, 2021, p. 19). Current climate models suggest that future drought events in Tuvalu are likely to fall more frequently into the category of 'extreme drought', rather the 'moderate' or 'severe' categories (Ilese *et al.*, 2021, p. 15).

Heatwaves are also likely to increase in frequency in Tuvalu according to current models. Currently, more research is needed to determine the likelihood that future heatwaves will regularly pass critical human health thresholds of roughly 35°C wet bulb temperature in Tuvalu (World Bank Group & Asian Development Bank, 2021b, p. 9). The Western Tropical Pacific has been identified as a global hotspot for future climate change-related marine heatwaves (World Bank Group & Asian Development Bank, 2021a, p. 9). Although literature specifically focused on heatwaves in Tuvalu is limited, respondents in a study conducted in the Republic of the Marshall Islands (RMI) reported numerous adverse impacts of heatwaves in their communities, including the death of livestock and crops and the movement of fish outwards from the islands (van der Geest *et al.*, 2020, p. 116). The study also found that people were more likely to make the decision to migrate away from RMI after periods of extreme heat. This finding suggests that even though out-migration can be influenced by a complex array of factors, heat is a relevant

trigger for relocation in the context of RMI (van der Geest *et al.*, 2020, p. 125). Given the geographical similarities between RMI and Tuvalu, this study could perhaps provide some insights into how heatwaves could impact residents of Tuvalu as well.

Tropical cyclones and typhoons are another significant hazard in Tuvalu. Tuvalu has experienced two tropical cyclones in the past decade. Tropical Cyclone (TC) Pam occurred in Tuvalu from 10–11 March 2015 and impacted 4,613 people. TC Tino occurred in Tuvalu on 28 January 2020 and impacted 5,500 people (EM-DAT: The International Disaster Database, 2021). Waves generated by tropical cyclones and storms can have severe impacts where they make landfall. In addition to human mortality and morbidity, as well as infrastructural damage, cyclones can also have impacts such as coastal erosion and salinization of soil. The IPCC defines a storm surge as “a temporary increase, at a particular locality, in the height of the sea due to extreme meteorological conditions (low atmospheric pressure and/or strong winds). The storm surge is defined as being the excess above the level expected from the tidal variation alone at that time and place” (IPCC, 2014, p. 1773). Current projections suggest that the severity and impacts of cyclones will worsen over time due to climate change. For example, the maximum windspeed of the most intense super typhoons is projected to increase from its present rate of 70–75 metres per second (m/s) to 85–90 m/s in the north-west Pacific by the end of the 21st century (Hongo *et al.*, 2018, p. 20).

Annex 4: Other ongoing EWEA engagements in the region

To inform the wider GCF project, part of the study also looked at exploring past EWEA projects and engagements in Tuvalu and more generally in the Pacific, to inform the range of initiatives that have occurred and the organizations that have been active in the region.

Climate Risk & Early Warning Systems (CREWS): One of the most prominent EWEA initiatives in the Pacific currently is CREWS, the World Meteorological Organization (WMO) specialized CREWS Initiative, which operates in Least Developed Countries (LDCs) and Small Island Developing States (SIDS). CREWS Pacific is co-funded by the Government of Canada, with the aim of “strengthening hydro-met governance, mechanisms, and warnings in 14 states to alert and instigate behavioural change that minimizes risks to lives and livelihoods” (CREWS, 2021, p. 32). Additionally, hazard assessments were completed and analysed for impact-based coastal inundation flooding in the country (CREWS, 2021, p. 32).

FINPAC: One of the major early warning initiatives to occur in both Tuvalu and Palau was the 2012–2015 Finnish-Pacific (FINPAC) Project entitled ‘Adapting to Climate Change in Oceania’. The aim of this project was to reduce the vulnerability of Pacific Island Countries (PICs) villagers’ livelihoods to the effects of climate change, in part through the development of regional CREWS (Final Evaluation of the Finnish-Pacific Project, 2018, p. xi). This project spanned fourteen PICs, including Tuvalu and Palau. It was overseen by SPREP. The Finnish Meteorological Institute (FMI) provided technical assistance to local meteorological (“meteo”) offices on the islands by installing software packages for meteo data analysis, weather forecasting and severe weather alerts to build their forecasting capacity. The impact assessment following the project’s conclusion found that a strength of the project was involving the community directly in vulnerability assessments, which led to the creation of disaster response plans and early warning systems. However, the final evaluation of the report commented that the project’s scope was focused more on developing early warning systems than on specific actions to be taken in advance, which had been a suggestion in the mid-term review (Final Evaluation of the Finnish-Pacific Project, 2018, p. 41).

Pacific climate science: Another initiative which occurred in the region was a 2013 communications outreach project in the form of a video called ‘The Adventures of Climate Crab’, jointly coordinated by IFRC, the Government of Australia, the Government of Vanuatu, CSIRO and GIZ (McNaught *et al.*, 2014, p. 1499). It follows the adventures of a small crab, utilizing visual storytelling methodologies to spread accessible information about various climate hazards and their impacts in different parts of the Pacific. The video is accompanied by a publicly accessible toolkit for facilitators and educators which includes a handbook and slideshow presentation.