



Australian  
National  
University

# **Consultancy to prepare a National Climate Change and Health Policy and Revised Action Plan for the Republic of Marshall Islands**

## **Policy, 5-Year Action Plan, and Circulation List**

February 2021

Authors: Sotiris Vardoulakis, Christine McMurray, Lachlan McIver, Liz Hanna, Amelia Joshy, Aparna Lal, Robyn Lucas

National Centre for Epidemiology and Population Health

Research School of Population Health

College of Health and Medicine

+61 2 6125 0657

[sotiris.vardoulakis@anu.edu.au](mailto:sotiris.vardoulakis@anu.edu.au)

The Australian National University

Canberra ACT 2601 Australia

[www.anu.edu.au](http://www.anu.edu.au)

CRICOS Provider No. 00120C

# Table of Contents

Glossary.....	5
Foreword.....	9
Vision Statement.....	10
Summary .....	11
1. Introduction .....	12
1.1. Background .....	12
1.2. Policy Context.....	15
1.3. NCCHP v2 Development Process .....	18
1.4. NCCHP v2 Goals.....	19
2. Evidence .....	20
2.1. Climate-sensitive health risks and priorities.....	21
2.2. Vulnerable populations .....	32
2.3. Health systems and infrastructure .....	33
2.4. Evidence gaps .....	34
3. Empowerment.....	39
3.1. Key stakeholder and community engagement.....	39
3.2. Communication.....	39
4. Implementation .....	41
4.1. Food safety and security.....	41

4.2.	Water safety and security .....	42
4.3.	Vector-borne diseases.....	43
4.4.	Non-communicable diseases.....	44
4.5.	Mental health and psychosocial well-being.....	46
4.6.	Respiratory diseases .....	48
4.7.	Extreme weather events .....	50
4.8.	Barriers and enablers for implementation .....	52
5.	Conclusions and recommendations .....	53
	References .....	54
	Appendix 1: Circulation List .....	59
	Appendix 2: Action Matrix .....	62

## Glossary

ACIAR	Australian Centre for International Agricultural Research
AG	Attorney General
ALRO	Alab Lebje Relatives Organization
AMI	Air Marshall Islands
ANZ	Australian and New Zealand
BOMI	Bank of the Marshall Islands
CAP	Comprehensive Adjustment Program
CCA	Climate Change Adaptation
CCD	Climate Change Directorate
CMAC	Coastal Management Advisory Council
CMI	College of the Marshall Islands
COPD	Chronic Obstructive Pulmonary Disease
CSO	Central Statistics Office
DAC	Development Assistance Committee
DRM	Disaster Risk Management
EIA	Environmental Impact Assessment
ELEFA	Enemanit-Latuma Extended Family Association
ENSO	El Niño Southern Oscillation
EPA	Environmental Protection Authority
EPPSO	Economic Policy, Planning and Statistics Office
IWRM	Integrated Water Resource Management
JNAP	Joint National Action Plan
KAJUR	Kwajalein Atoll Joint Utility Resources
KIJLE	Kora in Jiban Lolorjake Ejmour (promoting weight loss and improved health)
LRC	Local Resources Committee
MALGov	Majuro Atoll Local Government
MAWC	Majuro Atoll Waste Company
MBC	Marshalls Broadcasting Company

MCG	Forum Ministerial Contact Group on Fiji
MEC CRP	Marshalls Energy Company Comprehensive Recovery Plan
MEC	Marshalls Energy Company
MICNGOs	Marshall Islands Council of Non-Governmental Organizations
MICS	Marshall Islands Conservation Society
MIDB	Marshall Islands Development Bank
MIEPI	Marshall Islands Epidemiology & Prevention Initiatives
MIJ	Marshall Islands Journal
MIMA	Marshall Islands Mayors' Association
MIMRA	Marshall Islands Marine Resources Authority
MIOFA	Marshall Islands Organic Farmers Association
MIR	Marshall Islands Resort
MISAT	Marshall Islands Standard Achievement Test
MISC	Marshall Islands Shipping Corporation
MISGLB	Marshall Islands Scholarship, Grant and Loan Board
MISSA	Marshall Islands Social Security Administration
MIVA	Marshall Islands Visitors Authority
MNRC	Ministry of Natural Resources and Commerce
MOCIA	Ministry of Culture and Internal Affairs
MOE	Ministry of Education
MOF	Ministry of Finance
MOFA	Ministry of Foreign Affairs
MOHHS	Ministry of Health and Human Services
MOJ	Ministry of Justice
MPW	Ministry of Public Works
MWSC	Majuro Water and Sewer Company
NCCHAP	National Climate Change and Health Action Plan
NCCHP	National Climate Change and Health Policy
NCCPF	National Climate Change Policy Framework
NCDs	Non-communicable Diseases

NDMO	National Disaster Management Office
NSDS	National Sustainable Development strategy
NSP	National Strategic Plan
NTA	National Telecommunication Authority
NTC	National Training Council
NTFC	National Trade Facilitation Committee
OCIT	Office of Commerce, Investment & Tourism
OCS	Office of the Chief Secretary
OEPPC	Office of Environmental Planning, Policy and Coordination
OLPC	One Laptop Per Child
PDMC	Pacific Developing Member Countries
PDO	Pacific Decadal Oscillation
PFRM	Public Financial Roadmap
PIDC	Pacific Island Developing Country
PIDP	Pacific Islands Development Program
PIFFA	Pacific Islands Forum Fisheries Agency
PSC	Public Service Commission
PWD	People With Disabilities
RCP	Representative Concentration Pathway
R&D	Ministry of Resources and Development
RECO	Research and Education Community Organization
RMI	Republic of the Marshall Islands
RWH	Rainwater Harvesting
SBA	Small Business Administration
SBDA	Small Business Development Agency
SBDC	Small Business Development Center
SE4All	Sustainable Energy for All
SIDS	Small Island Developing State
SPC	The Pacific Community (previously: Secretariat for the Pacific Community)
SPTO	South Pacific Tourism Organization

TB	Tuberculosis
T&C	Ministry of Transportation and Communication
USP	University of South Pacific
WAM	Waan Aelon in Majel - Canoes of the Marshall Islands Program
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization
WIB	Women In Business
WUTMI	Women United Together Marshall Islands
YTYIH	Youth to Youth in Health

## Foreword

This document is the National Climate Change and Health Policy and revised 5-Year Action Plan of the Ministry of Health and Human Services aiming to address the impacts of climate change on health in the Marshall Islands. Importantly, this action plan is the outcome of wide consultation with stakeholders and communities on how we can best protect the Marshallese population from the effects of climate change and improve the resilience of our health system.

Climate change is already having an impact on the environment and on the health and wellbeing of our people. We know that it causes sea level rise which results in coastal erosion, flooding, and seawater intrusion affecting freshwater resources. Water is precious to any country, and it is important to ensure it is available and safe for human consumption. Diarrheal diseases are common in the RMI, especially among children due to poor hygiene and unsafe drinking water.

Climate change is also affecting food production and consumption patterns in the RMI. Poor food quality and reduced availability of fresh produce lead to poor nutrition, which can further lead to obesity, diabetes, and poor growth and development in children. Climate change also affects the spread of vector borne diseases such as dengue, which can result in disease outbreaks like those we experienced in the recent past. The RMI population is already experiencing the impacts of climate change on their physical and mental health. Decisive action across all sectors is needed to protect the health of our people and improve the resilience of health services to these changing climatic conditions.

The Ministry acknowledges the support received in the development of this National Climate Change and Health Policy and Action Plan. We look forward to working with all stakeholders and communities to implement this action plan in the coming years.

## **Vision Statement**

Focusing on interlinked climate, environmental, societal and health issues, the vision of the revised National Climate Change and Health Strategy for the Republic of Marshall Islands is that everybody's body and mind are protected from the direct and indirect consequences of climate change. This is aligned with MOHHS's vision of healthy islands, "where children are nurtured in body and mind; environments invite learning and leisure; people work and age with dignity; ecological balance is a source of pride; and the ocean is protected to sustain our needs". It is also aligned with the vision of the World Health Organization that by 2030 all health systems in Small Island Developing States will be resilient to climate variability and change.

## Summary

Given the vulnerability of the Republic of the Marshall Islands (RMI) to the impacts of climate change, the Government of RMI has developed a comprehensive National Climate Change Health Policy and a 5-year Revised Action Plan (NCCHP v2) to support the effective delivery of the policy. The goal of the NCCHP v2 is to improve the coordination and effectiveness of measures aiming to lead the country into a climate-resilient and healthier future.

A range of stakeholder and community engagement and consultation methods were employed as part of the development of the NCCHP v2, including stakeholder workshops, targeted interviews, and focus group discussions. These consultations directly involved around 200 local stakeholders, including Government officials, Local Authority representatives, Traditional Leaders and landowners, businesses, non-governmental organisations, community groups, and residents, representing a significant cross-section of the RMI population.

A number of key health issues, including food and water safety and security, respiratory and vector-borne diseases, mental health, and extreme weather related impacts were identified as priorities. In addition, barriers for implementation, such as insufficient funding and human resources, apathy and stigma were highlighted. Responsible RMI agencies, strategies to manage these risks and timeframes were suggested. These include increased resource allocation, educational campaigns, and continuing communication and engagement particularly with Traditional Leaders, landowners, and community and faith groups.

Key areas of action include sustainable agricultural practices, advanced weather forecasts, increased water harvesting and water quality testing, promotion on healthy nutrition, elimination of mosquito breeding sites, improved waste disposal and recycling, better walking and cycling infrastructure, measures to promote sport and exercise for all, and flood and heat protection measures.

Successful implementation of the NCCHP v2 requires government and community commitment, as well as dedicated resources, technical expertise, and co-ordination across government agencies, local authorities, landowners and community groups. It is recommended that an influential “champion” who will have oversight and responsibility for the action plan, and a co-ordinating officer who will take care of the day-to-day delivery of tasks, be appointed at the MOHHS. Finally, it is recommended that this 5-year action plan be reviewed annually against a set of indicators and updated if needed.

# 1. Introduction

## 1.1. Background

The Republic of Marshall Islands (RMI) is a small island developing state (SIDS), with a total land area of 182 km<sup>2</sup>, spread across over 2 million km<sup>2</sup> of ocean (Figure 1). There are 24 inhabited atolls and islands, which are mostly remote and lie 2 meters above sea level on average. The RMI is exposed to a variety of climate related risks, including recurrent droughts, coastal hazards, tropical storms, and, to a lesser extent, typhoons.

The Marshallese population of approximately 59,000 inhabitants is largely concentrated in the capital Majuro and in Ebeye Island. Climatic impacts in the RMI are exacerbated by underlying vulnerabilities, including: high levels of poverty (with 20% of the population living on less than \$1USD/day); low elevation above sea level and the majority of the population living in coastal areas; a highly dispersed archipelago, making administration, communications, and operations challenging; fragile island ecosystems and limited fresh-water resources (vulnerable to over-use, contamination, and droughts); and a weak economic base (Nurse et al. 2014b).

Climate risks are particularly serious for Marshallese households because of their limited financial resources, which make adaptation to changing climatic conditions and recovery from disasters very difficult. Furthermore, certain population groups, such as women and children, people with chronic illness or disabilities, and those with lower socioeconomic status, are typically more vulnerable to the impacts of climate change due to their relatively limited access, use, and control over resources and services (IPCC 2012).

### *Location, environment, climate*

Historically, the RMI has been affected by extreme weather events. Coastal areas, as in many other low-lying islands around the world (Figure 2), are increasingly vulnerable to flooding and erosion aggravated by sea-level rise (SLR).

SLR in RMI has been 7 mm per year on average since 1993, which was more than double the global average (Keener et al. 2012). SLR, combined with king tides and wave action, are causing coastal erosion, flooding, and seawater intrusion into freshwater resources, which are all projected to increase in the course of the century (Storlazzi et al. 2018b).



Figure 1: Republic of the Marshall Islands map

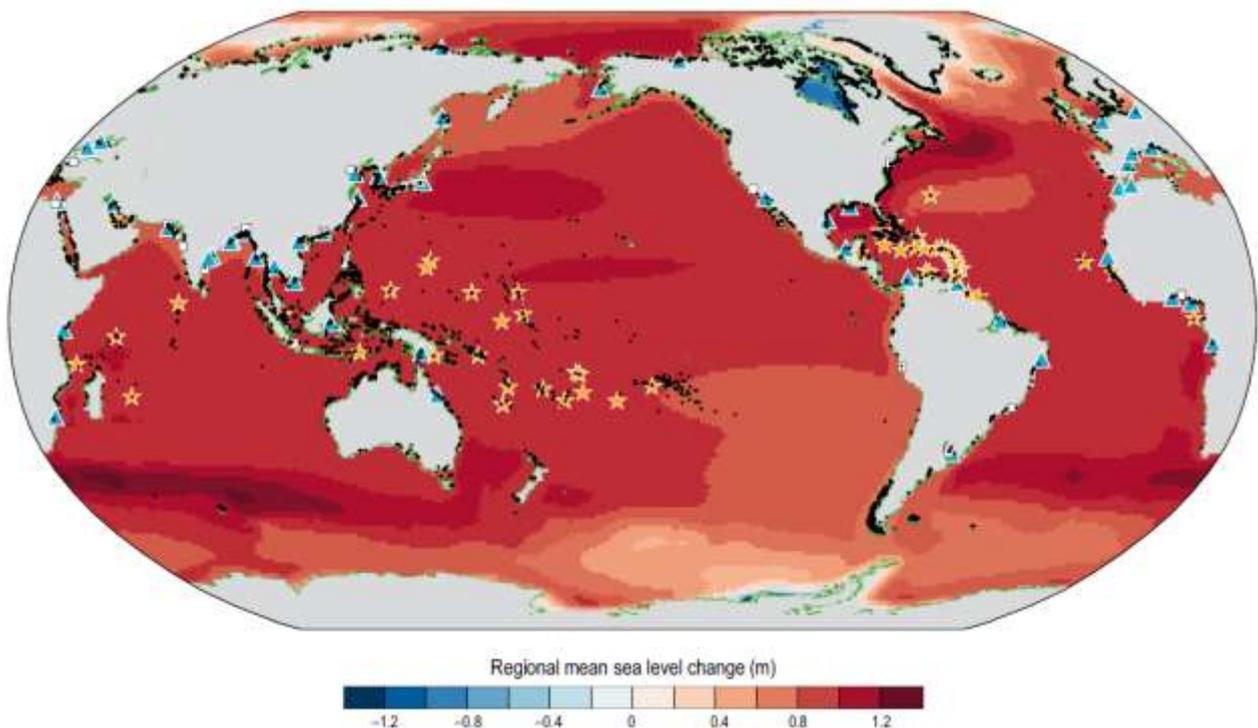
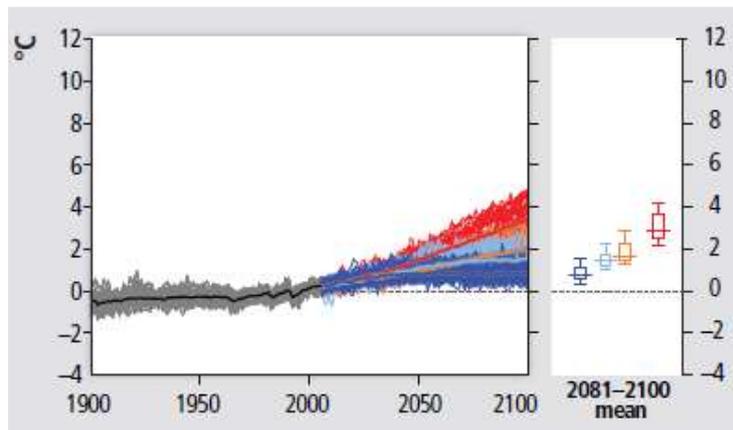


Figure 2: Global distribution of low-lying islands and coasts particularly at risk from sea level rise. Regional sea level changes refer to projections under Representative Concentration Pathway (RCP) 8.5 for 2081-2100 (Magnan et al. 2019).

Furthermore, RMI is experiencing increasing ambient temperatures and changing precipitation patterns that may have a negative impact on habitable land, crops and freshwater supply (Marra et al. 2017). Climatic projections indicate that the annual mean air temperature and extremely high daily temperatures will continue to rise in the RMI (Figure 3a). Although there is more uncertainty regarding future precipitation patterns (Figure 3b), climate models indicate a higher likelihood of extreme rain events in the course of the century. Ocean acidification is expected to continue, and the risk of coral bleaching is expected to increase (CSIRO 2014).

Public health and health services in RMI are highly vulnerable to the impacts of climate change and variability. The combined risks of increasing extreme weather events, high prevalence of obesity and non-communicable diseases, and infectious disease outbreaks challenge health service delivery and highlight the need for a strong and well-coordinated public health response.

(a) Air temperature



(b) Precipitation

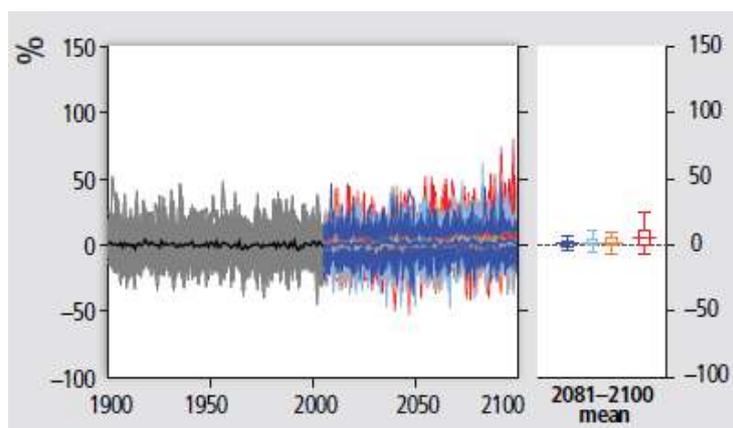


Figure 3: Annual projected (a) near-surface air temperature and (b) precipitation change relative to 1986-2005 for the Northern Tropical Pacific Time for four RCP scenarios. On the right hand side, the 5th, 25th, 50th (median), 75th, and 95th percentiles of the distribution of 20-year mean changes are given for 2081-2100 in the four RCP scenarios (Nurse et al. 2014a).

## *Health Sector*

In the RMI, climate change affects human health through multiple pathways, including increased risk of water-borne diseases (i.e. diarrheal diseases) and vector-borne diseases (i.e. dengue), increased food and water insecurity leading to poor nutrition, and disruption of health systems due to climate-induced extreme weather events and SLR (WHO 2015b). The combination of exposure to climatic hazards with limited capacity of the health system, including inadequate infrastructure, human resources, and supplies, as well as communities that are remote, provide significant challenges in reducing climate change-related health impacts.

The Ministry of Health and Human Services (MOHHS) works collaboratively with the Community Health Councils to provide healthcare services. The RMI has two hospitals (in Majuro and Ebeye) and 56 health care centres in the outer atolls and islands. Both hospitals provide primary, secondary, and (limited) tertiary care. Climate change poses a threat to the delivery of health services in RMI, particularly to health care facilities and infrastructure. The majority of the Marshallese population and health care facilities are located in close proximity to low-lying coastal areas and are highly vulnerable to cyclones, floods, storm surges, SLR, and interruptions in water supply caused by salination of freshwater resources, which are projected to increase in intensity with climate change. Damage to this infrastructure and essential supplies will affect the capacity of the health sector to provide services, particularly during emergencies.

### **1.2. Policy Context**

At the 23rd Conference of the Parties (COP23) to the United Nations Framework Convention on Climate Change (UNFCCC) in Bonn in 2017, the World Health Organization (WHO) launched a Special Initiative on Climate Change and Health in SIDS in collaboration with UNFCCC and the Fijian Presidency of the COP23. The Initiative recognizes that SIDS are on the frontline of climate change, given they face a range of immediate and long-term risks, including extreme floods, storms, drought and sea level rise; increased risks of water-, vector- and food-borne diseases; and other health impacts such as trauma, heat-related illness, malnutrition, non-communicable diseases and psychosocial disorders. The vision of the SIDS Initiative is that by 2030 all health systems in SIDS will be resilient to climate variability and change (WHO 2018).

The 2050 RMI Climate Change Strategy 'Lighting the Way' (RMI 2018) outlines a pathway for the RMI to facilitate adaptation and climate resilience in a way that ensures the future protection and prosperity of the country and its people. Furthermore, it prioritizes an integrated approach that combines climate and disaster risk considerations in building resilience across the entire country and economy. Disaster risk management, as well as contingency and emergency response, are areas of focus for improving resilience,

including improved communication with outer islands and establishment of a financial mechanism to allow for rapid response and emergency funding. The RMI Climate Change Strategy recommends the review and consolidation of policies and measures on climate change adaptation and resilience, as well as social and economic policies. For the health sector, it highlights the importance of taking steps to increase the adaptive capacity and resilience of RMI's health system, with the most effective health adaptation strategies taking into account contextual factors to meet often highly localized adaptation needs. As part of this process, RMI should identify and assess the greatest health risks and shortcomings in the current health system in order to develop effective strategies for minimizing the risks of climate change on the health of the population.

This integrated approach also aligns with MOHHS's 3-Year Rolling Strategic Plan 2017–2019 “Kumiti Ejmour” (i.e. health is a shared responsibility) (RMI 2017). The Ministry's vision is to facilitate the concept of healthy islands, “where children are nurtured in body and mind; environments invite learning and leisure; people work and age with dignity; ecological balance is a source of pride; and the ocean is protected to sustain our needs”.

The MOHHS developed an initial National Climate Change and Health Action Plan (NCCHAP) in 2012, in collaboration with the World Health Organization (WHO) and with funding from the governments of South Korea and Japan. The NCCHAP (RMI 2012) was intended to be the key instrument through which the MOHHS contributed to the RMI Joint National Action Plan on Climate Change Adaptation and Disaster Risk Reduction (JNAP) 2014-2018 (RMI 2014). Specifically, the NCCHAP (RMI 2012) was created to address the health goals outlined in the JNAP. Although NCCHAP (RMI 2012) was a pioneering initiative, there was: (1) no funding or staff at the MOHHS to implement it; (b) progress in certain areas but no overall coordination; (c) no monitoring or reporting.

This current document provides an update to the earlier NCCHAP (RMI 2012), in the form of a National Climate Change and Health Policy and revised 5-Year Action Plan (NCCHP v2), which constitutes RMI's National Adaptation Plan for the health sector.

The development of this Policy and Action Plan has been based on extensive consultation with key RMI stakeholders and other members of the public (Vardoulakis and McMurray 2020), a review of the relevant scientific literature (Vardoulakis et al. 2020b), and an evaluation of the aforementioned NCCHAP (2012) (Vardoulakis et al. 2020a).

Focusing on overarching climate, environmental and health issues, and in line with both the ‘Healthy Islands’ vision for the Pacific region (McIver et al. 2017) and WHO's SIDS Initiative on climate change and health (WHO 2018), we initially identified the following needs to be considered as part of the revised NCCHP v2 for RMI:

1. Increase awareness of the direct and indirect health consequences of climate change across the RMI population, including policy-makers, the private sector, youth and the elderly, and those living in outer atolls;

2. Strengthen the capacity of health systems to provide protection from climate-related risks, including extreme weather events, sea level rise, and vector-, water-, and food-borne diseases;
3. Ensure that health concerns are addressed in decisions to reduce risks from climate change in other sectors;
4. Mobilize communities to better adapt to the health consequences of climate change, as well as other impacts, applying the healthy settings approach embedded in Healthy Islands;
5. Strengthen national capacity to develop and implement effective interventions to minimize climate-related health risks and enhance community resilience for adaptation, with special regard for the most vulnerable populations;
6. Reinforce existing programs and build the capacity of health and other related sectors in terms of infrastructure, human resources and financial resources;
7. Assess the health implications (including co-benefits and potential trade-offs) of decisions made on climate change by other key sectors, such as energy, agriculture, fisheries, industry, water supply and sanitation, transport, urban and rural planning, and advocate for decisions that would improve health.

To achieve measurable outcomes in the next five years, the revised RMI NCCHP v2 builds on:

- Existing RMI policies and frameworks;
- Extensive internal (MOHHS) and external consultation and communication;
- Strong leadership, a committed local “champion” (from the MOHHS), endorsement by government, and ownership by local communities; and
- A realistic implementation plan and a mechanism for attracting and applying funds from donors.

The NCCHP v2 for RMI follows the four strategic lines of action of the SIDS Initiative:

- Empowerment: Supporting health leadership to engage locally, nationally and internationally.
- Evidence: Identifying priorities and gaps, and building the business case for investment.
- Implementation: Preparedness for climate risks, and health-promoting mitigation policies.
- Resources: Facilitating access to climate and health finance.

These four components are interlinked, as shown in Figure 4. Evidence leads both to empowerment and access to resources. Both empowerment and access to resources lead to successful implementation of actions. The four components aim at making health systems in SIDS resilient to climate variability and change (WHO 2018).

This updated National Climate Change and Health Policy for RMI has a realistic and specific 5-year Action Plan, which will be fully integrated in the new Joint National Adaptation Plan (JNAP), currently under development. The NCCHP v2 intends to include specific actions, responsible agencies, resources required, indicative costs, implementation strategy (including timelines), and monitoring and evaluation (including measurable indicators). It is recommended that the action plan be reviewed and updated annually.

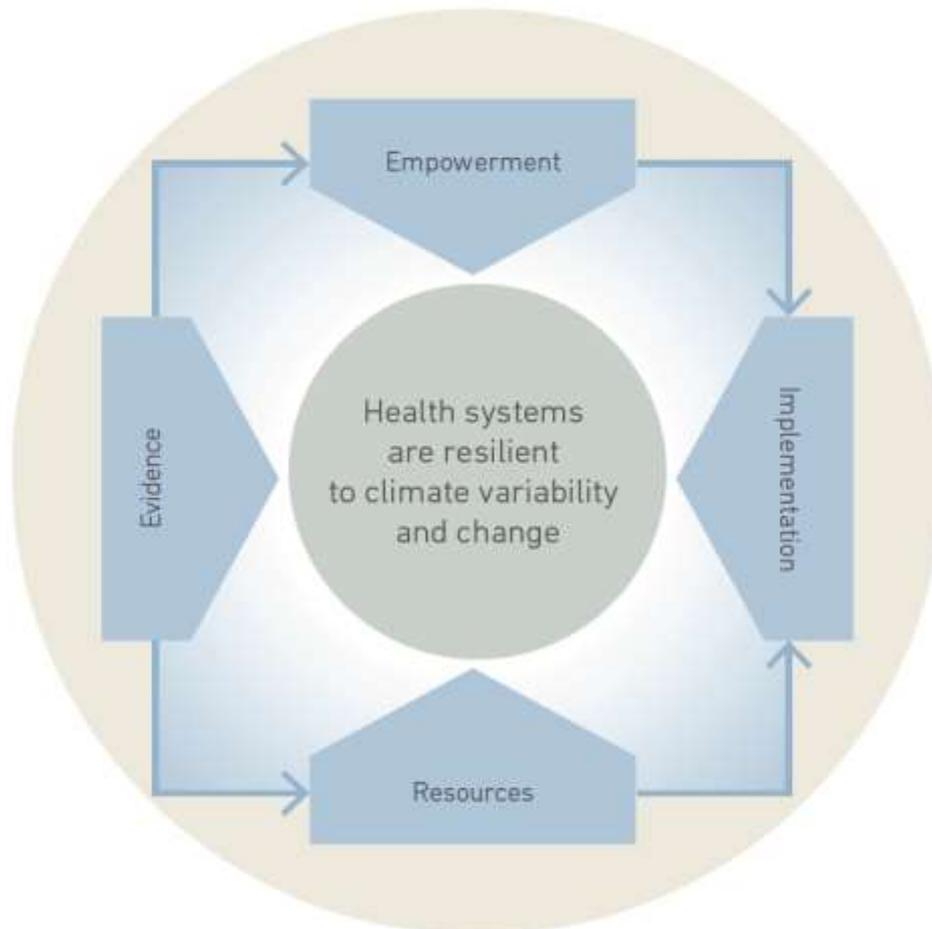


Figure 4: Interlinkages among the four components of the SIDS Initiative (WHO 2018).

### 1.3. NCCHP v2 Development Process

The NCCHP v2 development process involved:

1. Desktop review of the scientific literature on climate change and health in the Pacific Islands Developing Countries (PIDCs) and other SIDS.
2. A preliminary review of climate change and health research, initiatives, policies and plans relevant to RMI. This review included both studies published in the scientific

literature and those made available through government and international organizations, such as WHO.

3. Mapping of and consultation with a wide range of institutional and community stakeholders in RMI.
4. A range of participatory research methods for consultations, including a rapid survey, in-depth interviews, focus group discussions, and stakeholder workshops.
5. Advice and input from national and international experts in public health, environmental health, environmental management, and climate change.

Advice was sought from experts in the RMI MOHHS, the Australian National University, WHO and other organisations through formal and informal contacts. This included a qualitative assessment of achievements of NCCHAP (RMI 2012).

#### **1.4. NCCHP v2 Goals**

Based on the findings from the above process, the NCCHP v2 sets out three main goals and related areas of work aligned with the JNAP:

##### **Goal 1: Improved health protection against climate-related risks in the RMI**

- Identify and prioritize climate-related health risks in the RMI.
- Strengthen health protection measures against climate-related infectious (i.e. communicable) and non-communicable diseases.
- Improve public health education and awareness of effective health protection measures.
- Identify gaps, resource needs, and monitor progress.

##### **Goal 2: Enhanced community resilience and improved health and wellbeing**

- Reduced vulnerability to vector-borne diseases.
- Reduced vulnerability to food- and water-related health risks.
- Reduced vulnerability to extreme weather events.
- Improved mental health resilience and social connectedness.

##### **Goal 3: Integrated approach to health and climate change adaptation**

- Health protection policies are integrated into the National Adaptation Plan.
- Improved co-ordination between responsible Government departments and agencies on health protection, health promotion, climate change adaptation, sustainable development and planning.
- Key stakeholders and communities are active participants in the development and implementation of the NCCHP v2.

## 2. Evidence

The following sections provide an overview of the contemporary climate-sensitive health risks considered most relevant to RMI. These risks have been identified based on the vulnerability assessment conducted as part of the country’s NCCHAP development in 2011-2012, the findings of WHO’s regional climate change and health vulnerability assessment and adaptation planning project (published in a 2015 report and summarised in Figure 5) and the updated literature review, key informant interviews and stakeholder consultations conducted as part of this project.

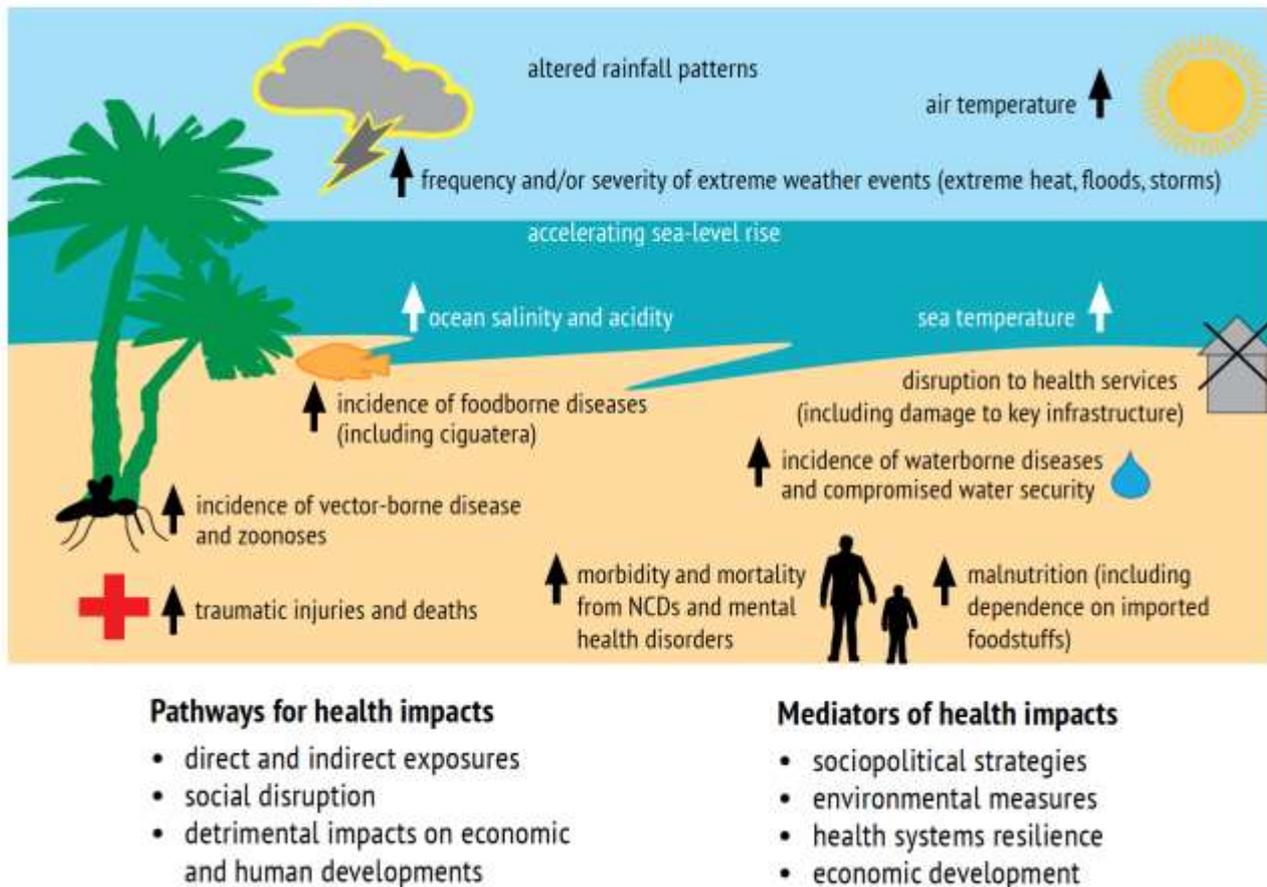


Figure 5: Pathways by which climate change may affect health in PICs (WHO 2015a)

The topics summarised below include:

1. Food security, malnutrition and non-communicable diseases
2. Food safety and food-borne illnesses (including ciguatera)
3. Water security, water safety and water-borne illnesses
4. Vector-borne diseases and zoonoses
5. Mental health and psychosocial well-being
6. Respiratory diseases
7. Extreme weather events

## 2.1. Climate-sensitive health risks and priorities

### 2.1.1 Food security, malnutrition and non-communicable diseases

There is a growing body of evidence linking climate change, food insecurity, malnutrition and non-communicable diseases (NCDs) (Barnett 2011; Savage et al. 2020a). This is especially problematic in PIDsCs such as RMI, where the burden of NCDs such as diabetes, cardiovascular disease and certain types of cancer, and their associated risk factors, particularly obesity, are among the highest in the world, as are the exposure and vulnerability of communities to the impacts of climate change (Sarfaty et al. 2019; Smith 2019). The links between climate change, food security, malnutrition and NCDs are summarised in Figure 6.

Climate change is predicted to have a significant detrimental impact on food security in many PIDsCs (Savage et al. 2020a). In general, the lack of access to nutritional food sources is a greater challenge in PIDsCs than food availability *per se* (McCubbin et al. 2017), but the converging problems of declining fisheries and agricultural yields, increasing consumption of energy-dense imported foods, and a loss of desire and/or ability to perform physical work and exercise in hotter conditions, are considered to be contributing, inexorably, to the rise in NCDs. Access to fish – a key element of the diet of Pacific Islands people – will likely decrease due to the adverse impacts of climate change (sea water warming and acidification, in particular) on coastal fisheries and coastal aquaculture (Cvitanovic et al. 2016; Jenkins et al. 2018). Recent years have seen an increase in the shift away from traditional foods towards imported, processed foods in many PIDsCs (Connell 2014). At the same time, impacts of climate change, such as droughts and further intrusion of saltwater, adversely impact agriculture and increase dependence on easily accessible imported foods, which are typically much higher in caloric, sugar and trans-fat content (Ahlgren et al. 2014).

The absence of traditional food sources affects lifestyle choices more broadly. Traditional farming and fishing practices are being slowly eroded as traditional food sources diminish. This change in lifestyle ultimately shifts towards a more sedentary way of life, contributing to obesity in adults, while at the same time contributes to the under-nutrition and micronutrient deficiencies observed in Marshallese children (Blankenship et al. 2020). Physical inactivity is also linked with NCDs (Smith 2019). Initiatives which aim to change food or lifestyle choices should ideally be owned and driven by local communities, to ensure that changes are sustainable (Hoy et al. 2014). Policies in this area should adopt a multidisciplinary approach that takes into account both environmental and public health priorities (Kingsley et al. 2015).

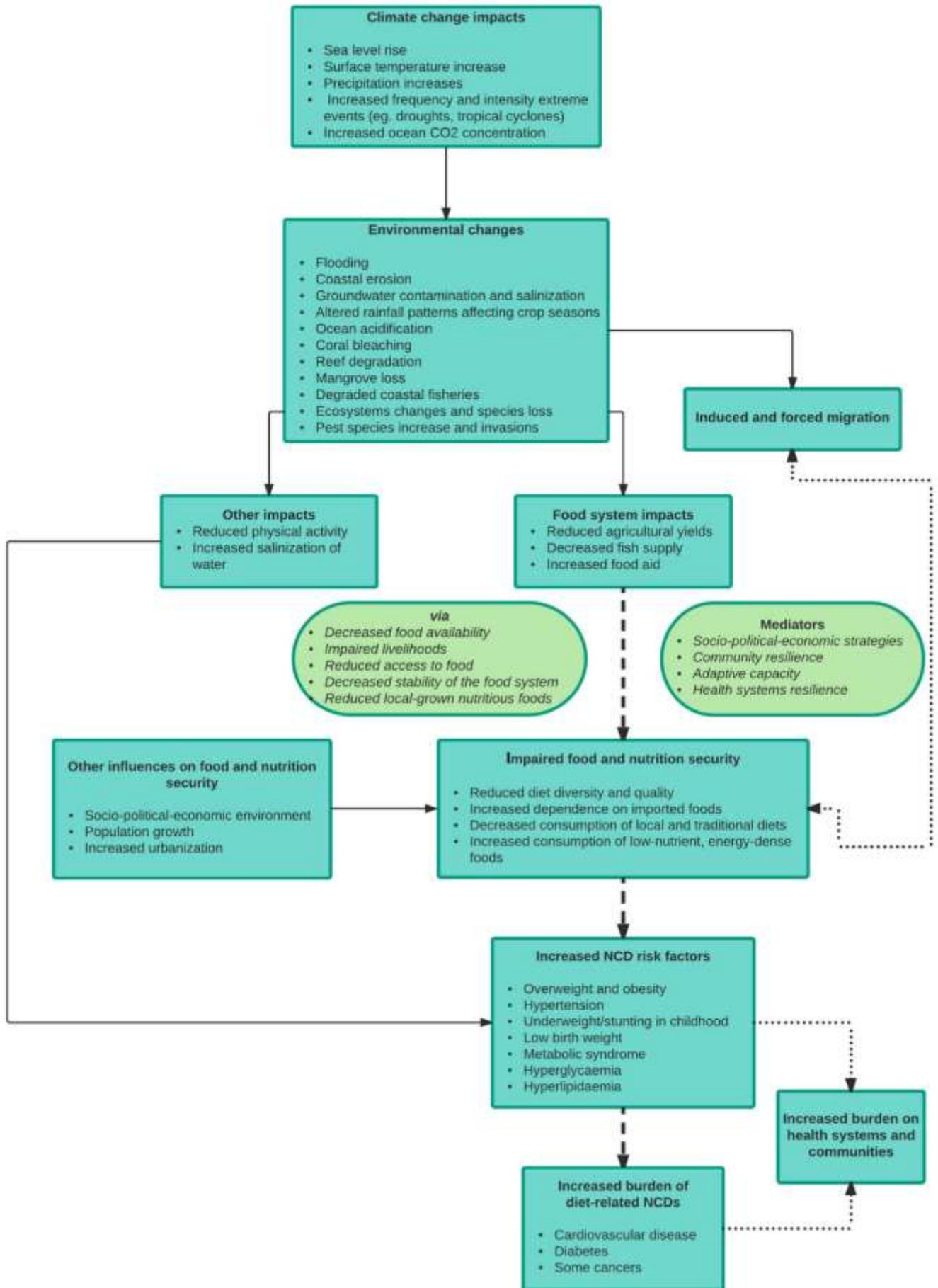


Figure 6: Links between climate change, food security, malnutrition and NCDs (Savage et al. 2020b)

### 2.1.2 Food safety and food-borne illnesses

Diarrheal disease is a major cause of morbidity in RMI, with gastroenteritis one of the most common diagnoses both in the emergency rooms of the two main hospitals (Majuro and Ebeye) and in outpatient clinics across the country. Diarrheal illness is most commonly spread via person-to-person contact or through contaminated food or water. Incidence of diarrheal illness tends to increase with increasing temperature, including in PIDCs (Singh et al. 2001).

There is also a link between diarrheal illness and traditional, cultural practices in the Pacific Islands such as community feasting. An outbreak of acute gastroenteritis on Ebeye in March 2009 led to over 80 admissions at Ebeye Hospital. This was the worst gastroenteritis outbreak in Ebeye's history, and in terms of the number of hospitalised patients was one of the worst of any published outbreak anywhere in the world. An epidemiological investigation of the outbreak suggested that the source was sandwiches (ham, egg, mayonnaise) and the likely offending organism was either *Staphylococcus aureus* or *Bacillus cereus*, both of which produce a toxin when allowed to replicate in warm, unrefrigerated conditions. The obvious implication of this finding is that warmer conditions in the future may lead to more frequent outbreaks of this nature in the absence of appropriate regulations, environmental health practices, and individual and cultural behaviour change.

Ciguatera poisoning, due to accumulation of a toxic organism in the marine food chain, has long been considered a significant public health issue related to food safety in the Pacific region (McIver et al. 2016; Rongo and van Woesik 2013). The link between ciguatera and climate change is less clear, although some evidence suggests that disturbances in coral reef ecology, such as those which occur with changing ocean temperatures and following tropical storms, may lead to an accumulation of herbivorous fish, which in turn increases the risk of toxicity when consumed by humans (Rongo and van Woesik 2013; Skinner et al. 2011).

### 2.1.3 Water security, water safety and water-borne illnesses

Ongoing and intensifying drought conditions driven by climate change can result in diarrhoeal disease outbreaks in PIDC. In Tuvalu, in 2011, a diarrhoeal disease outbreak was reported following a prolonged drought leading to water scarcity (Kool et al. 2012). Water scarcity can lead to long-term storage of water for consumption and if facilities are inadequate, this may increase microbial contamination.

As well as drought, heavy rainfall events are positively associated with an increase in diarrheal disease presentations (Singh et al. 2001). Threats to water security because of extreme climate events, such as prolonged drought or flooding, can result in diffuse health

impacts, exacerbating social issues and mental health in PIDC. For example, flooding has been linked to outbreaks of water-borne leptospirosis in Fiji (Togami et al. 2018).

Access to water and hygiene is an important priority. Using the most recent data from the WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene ([www.washdata.org](http://www.washdata.org)) to assess potential access to water, sanitation and hygiene (WASH) services across 21 Pacific Island nations (excluding Australia and New Zealand), considerable gaps in water and hygiene access were documented. Only four nations (RMI, Solomon Islands, Vanuatu, and Federated States of Micronesia (estimates from 2005)) had data on household handwashing and hygiene facilities. Rural areas in the RMI, Solomon Islands and Vanuatu had a higher percentage of households with no facilities for water and soap, and a lower percentage of households with basic facilities for water and soap, compared to urban areas (Lal et al. 2020).

Inadequate drinking water and sanitation infrastructure is an issue for RMI, with similar issues appearing in many other PIDCs (Ebi et al. 2006). For example, urban communities in Kiribati have limited access to clean water for drinking and washing, brackish water, and inadequate storage facilities. Communities have cited limited toilet facilities and concerns about contamination due to the lack of maintenance and improvement of existing toilets in Kiribati (Cauchi et al. 2020). The Palau Climate Change Policy for Climate and Disaster Resilient Low Emissions Development (2015) identifies increases in water borne diseases and damage to water and sewage infrastructure because of extreme weather events.

In PIDCs, there already exist policy vehicles, which can be modified using the proposed five-year action plan to target water safety and security issues.

#### **2.1.4 Vector-borne diseases and zoonoses**

The main vector-borne diseases (VBDs) of contemporary concern in RMI are viruses transmitted by mosquitoes of the *Aedes* genus. These include Zika virus, dengue fever virus and chikungunya (Canyon et al. 2016; Descloux et al. 2012; Filho et al. 2019). All of these VBDs have been recorded in RMI in recent years, including an outbreak of thousands of dengue cases in 2011-2012 (Sharp et al. 2014) – a disease to which many Marshallese mistakenly believed they were immune. While the illnesses caused by these viruses are usually mild, severe forms can occur – particularly with dengue, where infection can lead to fatal haemorrhagic disease. Furthermore, countries in the Micronesian region were among the first to note the in-utero long-term neurological complications of Zika virus (Filho et al. 2019), which was subsequently declared a Public Health Emergency of International Concern by WHO in 2016.

Mosquito-borne viruses have strong links with climatic conditions, in particular higher temperatures (leading to faster mosquito breeding and viral replication) and altered rainfall patterns (increased rainfall leads to wider availability of mosquito breeding habitats, up to the point where flooding flushes these away). Extreme weather events such as droughts

and high temperatures caused by climate change are projected to exacerbate the transmission of vector borne diseases (Ebi et al. 2006).

In addition to VBDs, RMI is also at risk of climate change-related increases in the burdens of disease from zoonoses, i.e. diseases spread from animals to humans. In the Pacific region, the zoonosis of most concern is leptospirosis, typically transmitted from rodents and domestic livestock such as pigs. To-date, the evidence for the burden of leptospirosis in RMI is scant (Guernier et al. 2018). As leptospirosis is most commonly transmitted to humans via water or soil contaminated with animal urine, the potential for altered rainfall patterns – particularly severe storms and flooding – to cause increases in exposure to and cases of leptospirosis in RMI may be extrapolated from the evidence of these effects in other PIDC such as Fiji (Lau et al. 2016).

Preventive strategies for VBDs and zoonotic diseases rely on a combination of community-level initiatives – particularly in eliminating mosquito breeding habitats to break the cycle of transmission – and personal protective behaviours. Increasing personal protective behaviours requires behavioural modification and increased awareness (Canyon et al. 2016; Filho et al. 2019). Enhanced disease surveillance, improved laboratory diagnostic capacity, and strengthening the health workforce – particularly in primary care and environmental health – are all critically important in ensuring future outbreaks are detected early and contained (McIver et al. 2014).

### **2.1.5 Mental health and psychosocial well-being**

Research into climate change-related mental health in RMI and surrounding PIDC has mainly focused on distress experienced while preparing for a disaster, during an ongoing disaster situation, and/or post-disaster (Asugeni et al. 2015; Dawes et al. 2019; Zahlawi et al. 2019). A study conducted in the Solomon Islands examined participants' thinking and behaviour relating to sea level rise. Participants expressed worry and reported that their worry affected individual and community behaviour (Asugeni et al. 2015). This is consistent with other studies conducted in SIDS which reported a strongly negative correlation between drought and life satisfaction. A weak negative correlation between floods and life satisfaction has also been observed (Lohmann et al. 2019). A study based in Tuvalu found that distress was linked to both ongoing and predicted climate change impacts (Gibson et al. 2019).

The prospect of forced migration to other islands and countries due to climate change and SLR may raise fears of having to abandon culture and customs, and loss of cultural knowledge among the children. Culture is deeply embedded in a nation's identity, and intricately aligned with a sense of place, such that forced migration to culturally distinct foreign lands heralds a permanent loss of place and a loss of the symbiotic relationship between place and self. Marshallese who have migrated to the USA report the 'sense of eternal homelessness' or 'placelessness' rests uneasily, even when home building and construction are based on homeland designs (Miller 2019). In the RMI, out-migration rates

are high, with one recent study reporting over 90% of respondents had at least one brother, sister, son or daughter who had migrated (van der Geest et al. 2020).

Decisions to migrate are multifactorial, and heavily weighted on seeking better opportunities for education, income and lifestyles. However, RMI households affected by heatwave and storm surge impacts and who perceived that these climatic events are worsening have higher migration propensities (van der Geest et al. 2020). Climate change-related issues of food and water insecurity, disease risk and inundation are existential, and perceived inadequate or inequitable responses adds to mental stress.

Collectivism has been described as a core cultural value among the Marshallese whereby “people do not think about themselves” . . . and . . . “everyone looks out for each other”(Nguyen-Truong et al. 2020). Focus group participants raised concern that climate change-driven reduction in core resources resulted in “less helping and sharing in the community because people have less to share”. Climate change thus threatens to also erode cultural identity.

Taken collectively, a loss of ecosystem services, the fundamental necessities of life such as a home, food, water, diminished livelihoods and being free of disease, coupled with potential decay in the mutual sharing and caring collectiveness which underpins cultural harmony and love of place, potentially poses a source of deep grief. Grief can turn to despair when possible alternative options, such as migration, receive negative reports.

Wellbeing falters without sound mental health, and this knowledge has gained increasing global awareness over recent years (Obradovich et al. 2018). Positive actions are therefore critical to protect mental health of citizens, and must be central to climate change adaptation strategies. Community connectedness and social capital have been long understood as protective of mental health.

The best chances for resilience in climate disaster are found when three types of social capital are combined across the social gradient. The first involves connections with a network of people who are similar; the second involves building relationships with people who are dissimilar (bridging social capital), providing access to new ideas, and by connecting across geographic, social, cultural, and economic lines. Finally, relationship-building with people and organizations who have authority (linking social capital) is critical to solving systemic problems faced by residents (Helland and Walkover 2018).

In the work for the NCCHP v2, respondents highlighted the need for strong mitigation actions and urging other nations to lower their emissions. Actions are also required at a local level to engender a personal sense of positivity, and bolster community cohesiveness. Of the strategies already trialled in the RMI, community clean-ups were rated very highly in achieving these goals for connectedness, whilst improving the health and amenity of the local region. Co-benefits include opportunities for physical exercise. Strategies involving shared vision, shared effort and delivering shared benefits can be

designed to incorporate these three types of social cohesion and provide adaptation benefits.

This area requires more research as there are few empirical papers on the mental health and psychosocial impacts of climate change in RMI and PIDCs (Asugeni et al. 2015). The capacity of health systems to cope with disaster situations and adapt to the impacts of climate change has been consistently identified as a barrier to well-being in PIDC (Ibell et al. 2015). A review examining post disaster mental health support in low- and middle-income countries (LMICs) found that while 57% of participants sought support from a health care professional, 45% of participants used community networks as a source of support (Zahlawi et al. 2019).

### **2.1.6 Respiratory diseases**

Climate change is expected to cause an increase in incidence of a range of respiratory illnesses. These include allergic conditions, obstructive airways diseases (including asthma) and respiratory infections (Mirsaeidi et al. 2016). The latter include those caused by bacteria (e.g. bacterial pneumonia, a common cause of illness and death in children and the elderly); viruses (e.g. those that cause upper respiratory tract infections, the single most common presentation to outpatient clinics in the RMI, as well as rarer but serious viral illnesses such as measles), and mycobacteria causing tuberculosis (TB).

TB, in particular, has a high prevalence in the RMI, affecting approximately 1 in 200 people (WHO 2015a; Yamada et al. 2016). Overcrowding, smoking, NCDs and poor sanitation have all been identified as risk factors for TB. Of particular concern in the RMI is the issue of overcrowding which, given the existing high rates of diabetes and smoking, has the potential to be exacerbated by sea level rise and population displacement, creating a “perfect storm” for TB transmission. RMI, along with other Pacific atoll nations, such as Kiribati and Tuvalu, is likely unique in the world in experiencing climate change as a driver of TB transmission (WHO 2015a).

The effects of the novel coronavirus 2019 infection (better known as COVID-19) on health systems, and individual behaviours that may lead to or protect against the transmission of respiratory diseases, are areas that will require additional research. While several Pacific Island countries and territories, including Fiji, Papua New Guinea, Guam, French Polynesia and New Caledonia, are reporting local transmission of COVID-19 at the time of writing, the extent of the epidemic in each country, and its impact in the RMI, remain to be seen (Craig et al. 2020; Mei and Hu 2020).

Of note, while the restrictions on international travel currently in effect may hinder the progress of initiatives to combat climate change, they have at least resulted in a small, temporary reduction in carbon emissions from air travel.

The COVID-19 pandemic may affect perceptions of food security, food safety, hygiene issues (such as handwashing, water quality, air quality) and place additional pressure on

the health infrastructure of RMI. In addition to personal protective measures, the single most important endeavour to protect against climate change-related respiratory diseases in the foreseeable future will continue to be vaccination, both of children (for measles and pneumonia) and adults (for influenza and pneumonia).

### **2.1.7 Extreme weather events**

Extreme weather events can be catastrophic for small nations. Two thirds of the countries with the highest disaster losses relative to gross domestic product (GDP) are SIDS, with average annual losses between 1 and 9% of GDP (GFDRR 2017). These average figures hide impacts of individual extreme events, since a single disaster can sometime cripple an island's entire economy. The RMI is no exception to this risk, as climate change is projected to increase frequency and intensity of climatic disasters across the globe.

The RMI Disaster Management Reference Handbook notes annual flooding could make the country's drinking water undrinkable by 2030 and is likely to inundate the islands entirely by 2050 (Republic of the Marshall Islands 2019). In recognition, the RMI Parliament, the Nitijela, declared a Climate Crisis Emergency in 2019, calling on the international community to consider additional support to low-lying atoll nations in their fight against climate change (RMI 2019b).

Tropical cyclones are the most extreme weather events, yet projection of future exposure to their effects in any specified area is complicated by their relative infrequency and short span of accurate historical data. Available projections suggest tropical cyclone frequency is likely to decrease as a global average between 6%-35% by the end of the 21st century, and a decrease between 20 and 50% is possible for the RMI (BoM and CSIRO 2014). However, an increase in the mean maximum wind speed of cyclones by between 2% and 11% globally, and an increase in rainfall rates of the order of 20% within 100 km of the cyclone centre, will increase their destructive capacity on the RMI (Knutson et al. 2010).

The frequency and intensity of tropical cyclones (hurricanes, typhoons) can be major factors degrading the ecological condition of reefs. The positioning of the RMI (at a latitude of about 7° N) offers some protection from tropical cyclones, which tend to avoid the equatorial regions and track beyond latitudes of 8° North or South (Puotinen et al. 2020). However, due to wind speed and wave formation the worst cyclone wave damage occurs within around 100 km of the storm track, and major coral loss can occur up to 800 km from a strong and widespread cyclone.

### ***Sea level rise***

The driving forces for SLR are continuing. Global average atmospheric CO<sub>2</sub> levels continue to rise. As more than 90% of the excess energy accumulating in the climate system arising from this increased concentration of greenhouse gases goes into the ocean, the oceans are warming (Cheng et al. 2019) setting a new record in 2019 (WMO 2020). Over 30% of SLR is attributed to the resultant thermal expansion of warmer water.

In 2012, SLR projected in the Marshall Islands was approximately 7-19 cm by 2030, increasing to 41-92 cm by 2090 under the RCP8.5 (BoM and CSIRO 2014). The accelerated ice melt from Greenland, Antarctica, and glaciers, is also contributing to faster than projected SLR. These recent measurements, coupled with advancements in monitoring and modelling, have resulted in an upwards revision in global SLR projections. Notably, these projections indicate sea level will be higher in the tropics than the global average.

Updated SLR projections specifically for the RMI are not yet available; however inundation reach has been calculated for Majuro Atoll for varying levels of SLR and tide levels (Gesch et al. 2020). High sea water levels can result in extensive inundation in agricultural regions, and airport runways surrounded by water may prevent aeroplanes taxiing or landing, thus preventing arrival of urgent supplies by air.

Land elevation is the primary geophysical variable that determines exposure to inundation in coastal settings. With an average elevation of approximately 2 m above mean sea level, the RMI is one of the lowest-lying island nation states in the world, making it highly vulnerable to the effects of SLR. Current rates of inundation are expected to increase as the rate of vertical coral accretion (growth) is slower than the rate of SLR (Storlazzi et al. 2018a).

Coral reefs are living bio-geomorphic systems whose structure and function highly depend on their health. Globally, reef health is under threat from local stressors, ocean acidification, and global warming; reefs are likely to degrade rapidly over the next 20 years (Hoegh-Guldberg et al. 2017). Healthy atoll structure is essential for foundational stability as a homeland, in providing resistance to wave pressures, and as a provider of food supplies. Human use of coral reefs also has profound effects on reef community structure (Crane et al. 2017). The dynamic relationship between reefs and the people who utilize them is complex and remains poorly understood. Estimating the relative and interactive effects of climate change and local anthropogenic stressors is difficult in most locations due to a lack of physical monitoring data (Bruno and Valdivia 2016).

### ***King tides, floods, and salination***

In addition to the chronic slow onset of SLR, incoming swell from distant storms and cyclones can trigger storm surges and wave run-up that lead to inundation (flood) events, especially when coinciding with high spring tides (“King tides”) and/or other sea-level anomalies. Also, the El Niño Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO) systems can raise or lower sea level by  $\pm 30$  cm beyond normal astronomical tide levels (Smith and Juria 2019).

In the RMI, the two highest sea-level measurements on record both occurred during La Niña events, with both leading to inundation. Approximately half of the inundation events

documented at the RMI were caused by tropical storms and cyclones / typhoons that passed near to the region (Smith and Juria 2019).

Wave-induced overwash and the resulting island flooding can cause injury and death, and readily contaminate an island's underlying thin freshwater lens with saltwater. This is particularly problematic when the freshwater lens is the sole or the primary source of water supply for island inhabitants. Seawater flood mixing with the aquifer groundwater can render the lens water non-potable. Partial recovery from saltwater intrusion into the lens can be swift, whereas full recovery to drinking water standards is very slow (Gingerich et al. 2017). Rainwater stored in tanks during the previous wet season may provide one month's supply, which is not sufficient for the island's needs during the subsequent five months of the dry season.

The WHO does not have a health-based standard for salt content of drinking water. Low levels of salt in drinking water are considered a negligible contribution to daily salt intake. However, several studies identified the association between excessive salinity in drinking water with increased risk of heart diseases, hypertension, risk of stroke, preeclampsia and gestational hypertension, infant mortality, cholera outbreaks, and skin and diarrheal diseases (Chakraborty et al. 2019). High water salinity is associated with significantly higher health burden and hospital visits.

Wave-induced overwash and the resulting island flooding also threaten terrestrial infrastructure. The RMI's isolation and scattered nature of hundreds of islands bring substantial logistic challenges associated with mustering and transporting resources vital to restoring safety and functionality of critical services. The RMI Disaster Management Reference Handbook details the comprehensive management system in place with regard to delivery of humanitarian cargo and utilities (RMI 2019a). The key lies in early warning systems that can accurately estimate likely disruption and restoration needs and have emergency assistance primed to arrive promptly.

### ***Droughts***

Drought presents another risk of climate change for the RMI, as rainfall contributes to over 90% of its water supply (RMI 2019a). Diminished groundwater supplies renders water quality unsafe for human consumption due to high salinity levels and damages food crops, such as banana, taro, and breadfruit.

A trend of decreasing annual rainfall has been evident in the RMI since 1954, although this trend is projected to reverse, with an increase in average rainfall, along with more frequent extreme rainfall events with higher rainfall totals (BoM and CSIRO 2014). A powerful El Niño event in 2015-2016 left the RMI in drought conditions throughout 2015-2017, which followed a severe drought in 2013. Thousands of Marshallese suffered from food and water shortages and practically the entire nation faced chronic water scarcity. The State of Emergency declared on 4<sup>th</sup> February 2016 was elevated to a National Disaster on 10<sup>th</sup>

March, whilst a State of Emergency was also declared in April 2017. These calls serve as the trigger to allow for international assistance to provide resources to cope with the crisis.

Health and social ramifications felt by RMI people during past droughts are diverse. Water is necessary for life. Hydration, the ability to cook and secure sanitation are fundamental to health, and indeed survival. Surveys in the RMI of drought-affected residents reported a sense of shame in having to beg friends and neighbours for water when their own reserves were down or they lacked the funds to purchase, needing to walk further to access potable water amid concerns about the dust on the health of children, and walking in the heat (van der Geest et al. 2020). The impacts of drought on food safety or shade-producing trees and plants encompass increased exposure to heat, reduced access to fresh, nutritious and affordable food, as well as potentially generating a sense of solastalgia (i.e. emotional or existential distress caused by environmental change) as the local amenity degrades. These events can incrementally erode the sense of pride and security of place.

Communities in the RMI have reported that 86% of households have experienced drought and 88% reported resilience measures of using multiple water sources to meet normal household needs (MacDonald et al. 2020). Reverse osmosis desalination units have provided relief during drought emergencies but concerns have been raised around dependency, maintenance challenges, and loss of traditional water practices.

### ***Heat effects***

Moderated by surrounding oceans and trade winds, temperatures in the RMI vary little throughout the year. The average daily maximum temperature at the Kwajalein Weather Station is 86.5°F (30.3°C); the average minimum is 77.6°F (25.3°C), and the average relative humidity ranges from 78% at local noon to 83% at midnight. Although extreme heat risks are unlikely, the high tropical humidity elevates the heat discomfort levels.

Warming trends have been observed in annual and half-year mean temperatures at Majuro since 1955 and Kwajalein since 1949 (BoM and CSIRO 2014). The temperature of the 1-in-20-year hot day is projected to increase by approximately 0.7°C by 2030 under the RCP2.6 (very low) scenario and by 0.8°C under the RCP8.5 (very high) scenario, and annual average daily maximum temperatures are projected to rise approximately 0.8°C and 1.5°C by 2030 and 2050 respectively under the higher emission scenarios (BoM and CSIRO 2014).

Global warming has already led to observed significant diverse changes in human health, productivity and wellbeing, sufficient to provide increasing confidence that continued warming will lead to mass migration, decreased economic output, increased morbidity and mortality, and lower human capital (Masuda et al. 2019). Whilst not immediately threatened with extreme heat events, exacerbation of the persistent heat and high humidity levels in the RMI may elevate the exposure to heat above human tolerance levels

(Hanna and Tait 2015). One manifestation is fatigue, which reduces capacity to work and willingness to engage in physical exertion.

## **2.2. Vulnerable populations**

Climate change vulnerability for the RMI spans the topographic, climatic and geophysical domains, all of which are amplified by the nation's demographic and socio-economic characteristics. Notwithstanding, the Marshallese are staunchly resilient. The successful inhabitation of these islands for several thousand years has conferred a deep multi-generational knowledge and cultural understanding of the local environment, and how to best survive and flourish amidst its challenges.

Vulnerability to climate change exists for all residents of the RMI through impacts on key resources through chronic climate-related shifts and extreme weather events. At the most fundamental level, the reef structure itself is under threat due to SLR, storm and wave damage, acidification and local degradation arising from human occupation. Reef health is vital to provide a safe home and as a source of marine-based food and water supply of the lens. Limited land availability and population pressures lead to increased population densities, most notably in Majuro and Ebeye, which in turn increases pressure on reef health, through ecological effects of industrial, commercial, agricultural and human waste run-off, and demand for fish and freshwater.

Certain population subgroups are more at risk than others to specific climate-related threats to health and wellbeing, and as in all populations poverty reduces capacity to adapt, and chronic health conditions and age reduce resilience to health challenges. The Asian Development Bank suggested that up to 20% of the RMI population were unable to afford their basic needs (RMI 2019a). Furthermore, the 2017 Borgen Project reported only 39.3% of the RMI population aged 15 years and above was employed (Tang 2017), with strong gender imbalance. Other aspects of women's lives perpetuate their disadvantage which transfers to children's disadvantage. Teen pregnancy rates in the RMI are the highest in the Pacific region at 127 per 1000 teenagers, fivefold that of Tonga, and RMI has the fourth highest infant mortality rate in the Pacific region with 30/1000 babies dying before their 1<sup>st</sup> birthday (RMI 2019a). Poverty and lack of opportunity to access essential resources and employment brings a cascading series of disadvantages that hamper options for healthy flourishing and amplify vulnerability to additional threats associated with climate change.

Environmental and economic issues are intricately linked with population health concerns. Due to a shortage of fresh fruits and vegetables, and reliance on imported processed and packaged foods, more than half of women in the RMI have obesity or risk factors for related diseases. Diet choices are shared with children, who comprise 46% of the RMI population. Of particular concern is reliance on processed foods which are

characteristically low in nutritional value, and high in calories, fats and salts. Whereas these are harmful for adults, they are especially risky in children's diets (Pries et al. 2019). Low nutrient, high salt diets, and consumption of water with high salt content contributes to a range of health conditions that escalate vulnerability to heat exposure. The human body tolerates only a small range in core temperatures, and maintaining this places considerable strain on the heart and cardiovascular system (Hanna and Tait 2015). Hence obesity, hypertension, dehydration, and lack of physical fitness all independently and synergistically increase the risk of heat stress.

### **2.3. Health systems and infrastructure**

The recommended approach to health systems strengthening in the face of climate change is the building of climate-resilient health systems (CRHS). In its 2019 'Special Initiative' report on climate change and health in SIDS, WHO reinforces the importance of the CRHS approach, which is itself an extension of WHO's overall guidance on health systems strengthening (Figure 7).

When examining the adaptation priorities for RMI, therefore, a concerted effort should be made to identify how those actions may align with the CRHS paradigm, as that is likely to be the best understood and most likely to be supported by donors and other health actors. Given the climate-sensitive health risks of greatest concern in the RMI include, as described above: water-, food- and vector-borne diseases; heat stress; malnutrition and NCDs; mental ill-health and psycho-social problems; and injuries and deaths from extreme weather events, adaptation priorities should both align closely with the highest-risk issues and support health systems strengthening more broadly.

The clearest example of this is primary health care. The frontline health providers and facilities, whether they be doctors, nurses, village health workers, traditional healers or others, are those who carry the greatest burden and care for the majority of the population. However, they are typically the most poorly trained sector of the health workforce, with their facilities the least well-resourced and most susceptible to shocks, whether they be financial, supply, environmental or other forms. Mainstreaming – that is, the incorporation of climate change adaptation into health systems strengthening initiatives – is therefore an essential element of building CRHS in the RMI. Vertical or isolated programmes, for example those that target only one area of the health system, are likely to be far less valuable and sustainable than those that address the health system as a whole. Herein lies one of the advantages of PIDCs such as RMI – they are small enough, in both population size and economic scale, that relatively modest investments in health systems strengthening and building of CRHS can have substantial benefits.

The COVID-19 pandemic is an example of evolving challenges facing RMI's health system. The threat of COVID-19, combined with risk of dengue outbreaks, floods and droughts, puts a significant stress on the health sector and the communities it serves. A

climate-resilient health system is now needed more than ever. This will protect the RMI from the health impacts of a climate change, and also provide multiple co-benefits for public health, including control of disease outbreak prevention and prevention of NCDs.



Figure 7: Building blocks of climate-resilient health systems (WHO 2015b)

## 2.4. Evidence gaps

It appears that the only additional scientific investigation of climate change-related health threats in RMI that has been conducted since the publication of WHO’s regional report in 2015 (WHO 2015a) and the corresponding research paper in 2016 (McIver et al. 2016) is a qualitative study of the links between climate change, migration and health in the context of RMI and its free association with the United States (van der Geest et al. 2020).

Therefore, new research on climate change and related health effects and preventive measures in RMI is needed. The most obvious priorities for such research include links to the main burden of ill-health in the RMI, namely NCDs. For example, an in-depth

exploration of the relationships between NCDs, food security, increased temperature and more severe extreme weather events. A focus on community knowledge, attitudes and practices and an evaluation of adaptive capacity and resilience factors in RMI would be valuable additions to the evidence base. Such evidence is emerging from other PIDs, such as Vanuatu (Savage et al. 2020b), but those findings are not necessarily generalizable to the context and culture of RMI.

An additional area of much-needed research in the region is the relationship between climate change and mental health and well-being. A recent study in Tuvalu demonstrated significant levels of anxiety and stress related to climate change – findings which are likely applicable to RMI (Gibson et al. 2020).

Table 1 provides a summary of the health issues/risks, evidence gaps, and short and long-term adaptation needs in RMI, based on the rapid literature review carried out as part of the development of the NCCHP v2.

**Table 1. Climate change and health risks, and related adaptation needs and priorities**

Health Issue	Risk (ie. likelihood x impact) posed by climate-sensitive disease in RMI	Needs / Gaps	Adaptation Strategies
Vector-borne diseases (VBDs)	High	Longstanding misconceptions and lack of preparedness regarding threats posed by VBDs.	<p>Significant strengthening required in this area given impact of previous outbreaks.</p> <p>Mosquito surveillance and control as well as community education and environmental health training will all be part of these essential processes.</p>
Diarrhoeal diseases (including water- and food-borne illnesses)	High	<p>Inadequate hospital preparedness for responding to an outbreak of water-borne illnesses.</p> <p>Limited public understanding/awareness re: risks of water borne disease transmission.</p> <p>Lack of strong coordination/communication between MOHHS and EPA.</p> <p>Lack of access to clean drinking water and/or water catchments.</p> <p>Inadequate sewage treatment facilities (worse in Ebeye).</p> <p>Lack of high-quality food-handling standards/regulations.</p> <p>Lack of understanding on part of public regarding safe food preparation and handling.</p>	<p>Rotavirus vaccination to infants.</p> <p>Health promotion and community education regarding clean drinking water, sanitation and hygiene.</p> <p>Train and improve the skills of health assistants in the treatment of patients with water-borne diseases.</p> <p>Improve water quality testing, food safety inspections and sewage treatment practices.</p>
NCDs, obesity, malnutrition and Stunting	High	<p>Lack of adequate consumption of healthy, nutritious, local foods.</p> <p>Lack of food choices (due to imported foods, processed foods and cost considerations).</p> <p>Low levels of physical activity.</p>	<p>Strengthen weight loss and physical activity programmes, including community-based healthy lifestyle and physical activities.</p> <p>Build partnerships with the other public, private and non-governmental organizations.</p> <p>Provide educational materials and information on local foods that are healthy and nutritious.</p>

			<p>Improve control of tobacco, alcohol and betel nut.</p> <p>Promote better nutrition, including subsidising sales of healthy foodstuffs.</p>
Mental ill-health	High	<p>MOHHS not sufficiently resourced to deal adequately or appropriately with patients with mental health issues.</p> <p>Lack of trained counsellors and other mental health professionals.</p> <p>Lack of community awareness regarding manifestations, prevention and management of mental health problems.</p> <p>Anxiety is an overlooked factor. It came up in the initial survey and discussions in RMI in January 2020.</p>	<p>Hire mental health professional staff.</p> <p>Create mental health policies and treatment guidelines.</p> <p>Conduct crisis assessment and treatment.</p> <p>Provide outpatient consultations and counseling.</p> <p>Conduct outreach visits in Majuro and outer atolls to schools and various communities.</p> <p>Develop Information, Education and Communication (IEC) materials on the services available.</p> <p>Coordinate with other medical departments and/or countries to strengthen psychiatric evaluation and treatment services.</p>
Respiratory diseases (TB and COVID-19)	High	<p>Lack of sufficient funds/resources for adequate management of TB in the community.</p> <p>Lack of public understanding re: symptoms/signs of TB and risks of transmission, with associated stigma.</p> <p>Lack of strong, well-coordinated primary health program for TB.</p> <p>High rates of household over-crowding and poor ventilation.</p> <p>Respiratory disease is related to health infrastructure and malnutrition. It is also linked to diabetes.</p> <p>One of top 10 diagnosis in RMI. Immunization levels still low.</p> <p>COVID-19 may affect perceptions of food security, food safety, hygiene issues.</p> <p>Maybe less relevant to climate change, but complementary to other plans and health priorities.</p>	<p>Strengthen vaccination programmes (i.e. for TB, influenza and pneumonia).</p> <p>Strengthen health promotion, prevention and early detection and adequate management of TB.</p> <p>Reduce outdoor and indoor air pollutants (including cigarette smoke).</p> <p>Improve environmental, occupational and personal hygiene (handwashing, surface disinfection, water quality).</p>

Measles	High	<p>Measles outbreaks can be deadly in countries experiencing or recovering from a natural disaster.</p> <p>Damage to health infrastructure and health services interrupts routine immunization.</p> <p>Overcrowding greatly increases the risk of infection.</p> <p>One of top 10 diagnosis in RMI. Immunization levels still low.</p> <p>Maybe less relevant to climate change, but complementary to other plans and health priorities.</p>	<p>Routine measles vaccination for children, combined with mass immunization campaigns in countries with low routine coverage, are key public health strategies to prevent measles outbreaks.</p> <p>Maintain high vaccination coverage rates of the complete range of childhood vaccinations offered routinely in the RMI.</p>
Traumatic injuries and deaths from extreme weather events	High/Medium	<p>This is potentially a high impact risk. MOHHS has limited capacity in terms of necessary medical supplies, pharmaceuticals, procedures, human and financial resources to react to injuries or deaths caused by an extreme weather event (including stockpiled supplies, et.).</p> <p>MOHHS has a Disaster Plan, but not enough of the key people are aware of this plan (e.g. medical/nursing staff).</p>	<p>MOHHS to review and update plans regarding safe storage of medical supplies and equipment (i.e. surge capacity planning).</p> <p>Disaster training for health and other staff.</p>
Ciguatera	Medium	<p>Lack of public understanding re: risks of transmissions, recognition of symptoms, etc.</p> <p>Anecdotal reports suggest that most cases of ciguatera are reported from Ailinglaplap and Jaluit.</p> <p>It could be become more of a problem in the future.</p>	<p>Health promotion and community education.</p>
Other effects including, temperature related effects and sun exposure	Medium/Low	<p>Lack of estimates of heat related mortality and morbidity.</p> <p>Lack of evidence of productivity loss due to extreme heat.</p> <p>Lack of public understanding of risks of excessive sun exposure.</p>	<p>Health promotion and community education.</p> <p>Adaptation in the built environment to avoid overheating through shading and other passive cooling methods.</p>

### **3. Empowerment**

Strong on-going engagement with stakeholders and making people more aware of climate change, weather phenomena and associated short- and long-term health risks will help support a proactive, evidence-based response system. This engagement will empower communities to take action and support the health leadership of the RMI in raising resources and implementing the NCCHP v2 in the next 5 years.

#### **3.1. Key stakeholder and community engagement**

A range of stakeholder and community engagement and consultation methods were employed as part of the development of the NCCHP v2. In addition to the engagement with MOHSS and other RMI government services, the importance of engaging strongly with traditional leaders (Council of Iroij) and landowners, as well as faith groups and other community groups, was highlighted from an early stage of the policy development process. To address this need, the following engagement methods were used:

- (i) a Climate Change and Health symposium that took place on 30-31 January 2020, and two stakeholder mapping workshops conducted in July 2020;
- (ii) a rapid survey, focus group discussions, and targeted interviews carried out in the RMI between January and March 2020.

These consultations directly involved around 200 local stakeholders in total, including Government officials, Local Authority representatives, Traditional Leaders and landowners, business, NGOs, community and faith groups, and residents, representing a significant cross-section of the RMI population.

Overall, the findings were very consistent, focusing attention on a number of key health issues, including food and water security, vector borne diseases, and mental health, and barriers for implementation, such as insufficient funding and human resources, apathy and stigma. Responsible RMI agencies and strategies to manage these risks were suggested, including increased resource allocation, education, communication and engagement, particularly with Traditional Leaders, landowners, and community and faith groups.

#### **3.2. Communication**

The success of the NCCHP v2 relies heavily on the ownership and support it receives from the MOHHS, other Government Ministries and Agencies, and importantly all sectors and levels of the community. This ownership and support will be made possible through a mechanism that provides on-going and targeted communication and raising awareness of the actions and their interconnectedness with broader health issues (NCD and infectious disease prevention), climate change adaptation, and sustainable development in the RMI.

An effective communication strategy is therefore required to ensure the goals and actions within the NCCHP v2 are understood and supported by stakeholders from local to national levels, and from Majuro and Ebeye to the Outer Islands.

Effective communication needs to be culturally appropriate, linked to traditional knowledge, tailored to diverse audiences and be delivered by trusted messengers through established pathways. This includes training for health practitioners on the use of climate, environmental and weather information, as well as climate change and health educational programmes for students and community groups.

## 4. Implementation

The following section describe specific actions for mitigating climate change-related health risks in the RMI.

### 4.1. Food safety and security

Food security is a major concern in the RMI as highlighted by the participants in the focus group discussions and in the stakeholder workshops. The actions recommended include practical improvements in agricultural practices, provision of more education and information on crop cultivation methods, and the need for preservation of fish stocks and control of ciguatera. Practical agricultural strategies may include introduction of more drought resistant crops, better techniques for preservation and storage of crops, and adoption of more water-efficient techniques for growing crops.

A general recommendation is that there should be more outreach and awareness-raising in sustainable agricultural techniques, including better management of water resources for crop growing. While there is much knowledge of traditional cultivation methods in RMI, most information on modern agricultural science is obtained from consultants and regional agencies, such as the Pacific Community (SPC), and from educational posters. The increasing importance of local cultivation in conjunction with the harsher environmental conditions associated with climate change is increasing the demand for agricultural advice, especially in techniques such as pest control, use of fertilisers, and safe use of grey water. Advice on safe post-harvest handling and storage of food crops is also needed to prevent diarrheal and other diseases. While general information can be provided in poster and media broadcasts, there is also a need for a small team of local agricultural advisers to identify specific problems in the field and provide targeted advice on the best way to address them.

Other recommendations about the types of food-related education and information that should be provided in conjunction with the JNAP include:

- Assessment of the scope for increased local food production and preservation (linked to the National Food Security and Sustainable Livelihoods Program).
- Identification and implementation of key practical strategies for increasing and diversifying local food production, including climate-resilient crops and replanting traditional foodstuffs (e.g. pandanus, koin, konnat, lukwe) and reducing dependency on imported foods.
- Assessment of ways of ensuring marine food security and protecting the coral reefs that support coastal fisheries.
- Strengthening, implementing and enforcing the RMI Food Security Policy (RMI 2013).

These activities will benefit from advice and interaction with the Centre of Excellence for Atoll Agriculture Research and Development in the Pacific, established in south Tarawa, Kiribati. Regional partnerships with the Australian Centre for International Agricultural Research (ACIAR) would also help promote local food production.

Some consulted stakeholders mentioned that cultivation of traditional medicines should be promoted as part of food security. As certain traditional medicinal plants may have both therapeutic and nutritional benefits, they should be considered in strategies to increase cultivation of local foods.

Ciguatera prevention is another perceived priority, especially as the decline in fish stocks is leading to consumption of types and parts of fish known to be more at risk of carrying ciguatera. Despite scientific research, so far no effective way of preventing outbreaks of the toxins that cause ciguatera in large reef fish has been found (Friedman 2008). The ciguatera problem is therefore best addressed by continuing community education, for example via posters explaining the risk and especially advising against consuming fish offal.

Actions to improve nutrition are addressed in the section on NCDs, below.

## **4.2. Water safety and security**

Water safety and security is a high priority for RMI in the context of climate change and public health. Data and characteristics on water access from outer islands are currently limited. Increased water quality testing and data on drinking water supplies, and community access to safe water in these areas should be prioritised. To do this efficiently, coordination with the Environmental Protection Authority (EPA) on water quality testing is needed. Indicators of this action could include an increase in the data available on outer islands and a national record of the number of water shortages and contamination events, coordinated by the EPA.

Increased engagement of the public health sector in raising awareness of water-related health risks is recommended. Communication and health promotion activities can be coordinated under the JNAP, where integrated awareness-raising campaigns to link water, pollution, public health, and food security are conducted. Educational materials on clean drinking water, sanitation and hygiene should be developed as part of this action. Given the widespread use of mobile technology, efforts should be made to strengthen public education on hygienic practices using available electronic media. Indicators of this action could include the development of online and printed resources for public health education.

Behavioural changes in waste disposal and recycling should be combined with an increase in the easy access to these facilities for the community. Indicators of this action could include the installation of accessible recycling and waste disposal facilities for the communities.

Overall, increased awareness of water-related health risks, together with improved protection of water catchments and drinking water sources and enhanced public health awareness campaigns, should lead to a decrease in water-borne disease over the medium term. In the short term, the reporting of water-borne disease cases should be monitored, with the aim to progressively reduce the number of reported cases.

The added risk of salination of water supply sources through over-wash of the lens from wave surges, and drought-induced reduced lens filling rates, requires escalation of efforts to preserve drinking water resources and reduce salt intake of the RMI population. It is important that this work runs complementary to efforts to reduce other sources of salt, such as inadvertent dietary intake through dietary shifts to processed foods. Food labelling and dietary education campaigns could be considered, thus offering multiple co-benefits.

The establishment of a central coordinating body (e.g. National Water Office) should be considered. This body will aim to increase protection of community water catchments across urban and rural areas, with members comprising government officials from the environment and health sectors as well as community leaders. The health sector, particularly public health, should be involved as a key stakeholder in this body. Indicators of this action could include the number of meetings across sectors on environment health and the development of a national plan for water.

### **4.3. Vector-borne diseases**

Numerous outbreaks of vector-borne disease, such as dengue outbreaks in recent years, have created a high level of awareness of vector-borne diseases in the Marshallese community, including considerable awareness of modes of transmission. This is evidenced by frequent community clean-ups and increasing use of mosquito nets and insecticides. The main obstacles preventing better control of vector-borne diseases are financial and organisational. These limitations can be seen at government, community and household levels. While on-going education and awareness-raising about vector borne diseases and the importance of eliminating mosquito breeding sites should continue, the main focus of the NCCHP v2 should be on addressing financial and organisational barriers and enforcing anti-litter and environmental regulations. Regulations concerning litter, storage of waste, and pollution control should be reviewed and if necessary updated to ensure they give sufficient power to authorities to enforce them.

The four-person Environmental Health Division of MOHHS should continue its good work and be augmented to increase its capacity for vector control beyond Majuro Atoll. At the same time there needs to be strict enforcement of regulations requiring vector breeding sites to be removed or covered, so that water cannot accumulate. In some cases, fumigation of mosquito breeding sites may be needed. For example, the very large outdoor tyre dump in Majuro supports potentially thousands of vector breeding sites that cannot be

eliminated by hand spraying alone. Elimination of such sites would greatly increase the effectiveness of the Environmental Health Division's vector control programme.

Coordination of community clean-ups is essential, especially in Majuro and Ebeye. Failure to coordinate undermines and discourages efforts; for example, if one community cleans up all its trash and eliminates breeding sites, but trash and breeding sites remain on adjoining land. Logistic support as well as coordination is needed so that any obstacles, such as problems associated with tenancies and landownership, can be removed. This could be addressed by employing a Clean-ups Coordination and Liaison Officer (or adding this responsibility to an existing post) to encourage clean-ups, engage with communities and landowners, and ensure coordination and cooperation.

Regular waste collection in urban communities and commercial areas is an essential part of vector control. Sufficient funds must be made available to ensure that collections occur regularly, e.g. weekly, and all urban areas are covered. Rural village communities should be encouraged and assisted to make their own arrangements for collection and safe disposal of trash. Financial limitations in waste management at the community level should be mitigated by local authorities, which should be able provide cleaning equipment, bags for collecting trash, and transport to remove the collected trash for safe disposal.

While remoteness, small population size, and high transport costs are on-going limitations as regards recycling in small island states, increased advocacy for re-using and re-purposing would help to reduce the overall amount of trash. This strategy should include discouraging unnecessary packaging and use of plastic shopping bags through community awareness raising and education.

#### **4.4. Non-communicable diseases**

Non-communicable diseases (NCDs) are an on-going and major health concern in the RMI that has been partially addressed in previous health plans, including the NCCHAP (RMI 2012). As NCDs are the leading cause of death in RMI, especially NCDs associated with diabetes and obesity, it is crucial that they continue to be a high priority in the 2021 NCCHP v2.

The NCCHAP (RMI 2012) identified the main pathways through which climate change is likely to affect NCDs as via altered dietary patterns (move from fresh to processed foods); population displacement; compromised food security; and altered human activity levels. Actions to promote and support increased cultivation of local crops (proposed above) will partially address the first and third of these pathways. In addition, on-going education and awareness raising about healthy nutrition should continue via school education, NGOs, and faith-based organisations. This includes providing information on the importance of a balanced diet, avoidance of foods high in salt, fats and sugar, and restricting alcohol intake. This needs to be supported by awareness raising campaigns to promote healthier food options (i.e. more access to and use of whole grains, unprocessed and traditional

foods) and healthier methods of cooking (i.e. less use of salt, sugar and frying in food preparation). These campaigns should target both households and food outlets.

Strategies to address population displacement are complex and were not seen as priority for the current NCCHP v2 by participants in stakeholder workshops and focus group discussions. The remaining actions proposed to address obesity and diabetes-related NCDs, therefore focus on increasing physical activity levels.

The MOHHS, in conjunctions with schools, NGOs, and faith-based organisations, needs to continue and intensify the on-going promotion and awareness-raising of the importance of physical activity for men and women of all ages. This includes encouraging the formation of clubs and other incentives to increase participation. It is especially important to make on-going efforts to change community perceptions that sport and exercise are only for young and/or fit people or only for boys/men. Promotion and awareness-raising need to be accompanied by efforts to increase the availability of facilities for sport and exercise for all.

High air temperatures in the RMI have always been a major factor limiting outdoor activities such as walking, running, cycling and team sports, while many participants in the focus group discussions and stakeholder workshops perceived temperatures as increasing with climate change. Air-conditioned indoor sports facilities, such as gymnasiums, are costly to build, equip and maintain, so the focus of this set of actions needs to be on simple modifications to the built environment that will promote exercise in the cool of the early morning and evening.

There are already many air-conditioned spaces in offices and public buildings around Majuro and Ebeye that could be used after hours for exercise sessions. Aerobics, Tai Chi and dance workouts provide many benefits while requiring little or no equipment other than a music player and a cleared space. Yoga and step workouts provide similar benefits with only a little more equipment. Some of these activities are already taking place, but promotion and support is needed to increase participation of men and women of all ages. A maintenance program for existing sports facilities, such as basketball and volleyball courts, is needed to ensure they are always safe and usable, with cracks repaired and weeds removed.

Safe and well-lit walkways and cycle lanes also provide opportunities for increased physical exertion through active travel. The stretch of footpath in the Lagoon Road to the east of the Majuro Bridge is a good example of a well-lit facility to encourage walking. Urban planners need to prioritise a long-term program of building footpaths in urban Majuro, smoothing the edges of urban roads, marking off separate cycle lanes and providing good lighting to encourage active travel and recreational walking and cycling when temperatures permit. This needs to be accompanied by a road safety awareness campaign to ensure walkers and cyclists are anticipated and treated with respect by motorists. Encouraging the formation of communal bike sharing schemes and clubs for

various age groups would help to increase uptake of walking and cycling for exercise. This may involve providing incentives for private companies to establish cycle hire businesses.

Swimming is an excellent form of exercise for men and women of all ages and is highly appropriate in hot climates, but opportunities for swimming tend to be limited by conservative attitudes inhibiting the wearing of practical swimwear, along with a scarcity of swimming pools and safe public areas for sea swimming. Attitudes are gradually relaxing, however, and the public beaches at Laura and near the airport in Majuro atoll have become popular spots for water play, if not swimming for exercise. Until now, pollution around Majuro has limited the creation of safe swimming areas by fencing off small sections of lagoon. As clean-ups proceed and sea water quality improves, however, a long-term objective should be the creation of safe swimming areas and the introduction of swimming lessons, lap training and water aerobics for men and women of all ages.

#### **4.5. Mental health and psychosocial well-being**

Mental health was a key theme that permeated throughout participant responses as a need to know, and a need to act. Awareness of climate change and health among community members and traditional leaders was reportedly patchy, and action was insufficient to address the pressing needs. It was recognised by stakeholders and participants in focus group discussions that poor mental health is sometimes stigmatised and fear of stigmatisation can be a barrier preventing individuals from seeking help. Another identified barrier was the marked variation in responses amongst individuals, groups and leaders in enthusiasm or level of effort, as well as efficacy of actions being adopted. There was strong agreement that at all levels throughout the RMI, positive, cogent and effective mitigation and adaptation responses were necessary, stressing they needed to be “implemented “and “well-coordinated.”

Given the substantive evidence which indicates that climate change negatively impacts mental health and psychological well-being, it is imperative that they are considered a priority within the NCCHP v2. As outlined in the evidence section, mental health and psychological well-being can be affected by short term climate events (i.e. cyclones and floods) and long-term climate events (i.e. drought and sea level rise) (Helland and Walkover 2018). The mental health needs of the population differ in accordance with the nature of the climate change-related event. Overall, it is important that initiatives aimed at promoting mental health and psychosocial well-being encompass both ongoing mental health services and emergency mental health response.

To improve overall mental health service delivery, health system facilities and resources should be reviewed in relation to mental health. Often PIDC’s struggle with fragmented health care systems and lack of trained health professionals. Strengthening mental health care capacity requires increasing the number of mental health practitioners and improving mental health care skills. Mental health training which is relevant to needs of the

population and include in-service training (i.e., continuing education) is essential. Other health care practitioners such as nurses, doctors and social workers also play an important role. Depending on the training level, health care practitioners can detect mental health problems, ensure adherence to treatment, refer complex cases, and provide support for caregivers (Kakuma et al. 2011).

Mental health service capacity building and awareness raising are both essential to improve mental health outcomes (Skuse 2018). Particularly in rural contexts, concerns have been raised regarding the lack of educational programs and infrequent follow-up sessions (Ibell et al. 2015). Local community networks are often in a better position to carry out such campaigns as they are not constrained by logistical issues that non-local organisations face. Consequently, community networks can play an important role in reducing mental health stigma and raising awareness of mental health and related services, which increase help-seeking behaviour. Traditional community-led initiatives and healthcare initiatives can provide complementary pathways to promote good mental health.

Responding to short term climate events often requires rapid response and large-scale response. The RMI WHO Country Cooperation Strategy 2018-2020 recommended the establishment of a dedicated team to prepare for and respond to emergencies and disasters (WHO 2017). Ensuring that mental health specialists are included in this team will help the delivery of mental health services during emergencies and disasters. However, mobilizing large teams of trained local mental health professional can be difficult and cultural differences can reduce the effectiveness of international aid. It is important to acknowledge the role of traditional and community networks in improving emergency mental health care capacity and resources. 'Train the trainer' programs are an intervention strategy which utilises traditional/community networks and have been successfully adopted in several LMICs. This enables local and international mental health professionals to train local non-specialists to provide mental health services. Local non-specialists, who may be survivors of disaster or displacement themselves, are well positioned to adapt to the cultural and environmental context. Local non-specialists often become an important first source of support for individuals who do not want to or cannot access other services (Zahlawi et al. 2019).

On-going education and awareness raising in the causes and nature of mental stress and associated mental health problems, including exacerbation by climate change, is a key strategy to reduce stigma and increase and normalise the use of mental health support services. Education and awareness-raising must be prioritised in any mental health strategy. At the same time, the number and availability of trained mental health professionals must be increased to ensure sufficient and adequate mental health services are available. This includes sufficient psychiatric nurses, psychologists and psychiatrists.

Mental health is sensitive area so it is particularly important that service providers understand and establish rapport with their clients. Service providers also need to understand and respect Marshallese culture. If additional trained staff are recruited overseas, customised orientation training will be needed to ensure they can deliver appropriate assistance to Marshallese clients. MOHHS should prepare a suitable orientation programme. Orientation should include forming links with local youth, sport, faith-based and other community groups that work in conjunction with mental health services to help improve mental health.

The promotion of exercise and participation in sport are important in any strategy to improve mental health and well-being in the community. The promotion strategies for RMI discussed above in the actions section in relation to NCDs also apply to the mental health strategy. What needs to be emphasised here is the importance of engaging all sections of the community in physical activity, including elderly men and women. Even very low intensity physical activity has been shown to help prevent mental deterioration and to enhance the well-being of the elderly. Strategies to promote sport and exercise should therefore include specific promotions of appropriate exercise for elderly men and women.

A strategy is also needed to address mental health problems in outer islands. This should include in-service training for health professionals on outer islands and atolls to raise awareness of the likely impact of climate change on mental health.

## **4.6. Respiratory diseases**

### ***Infectious respiratory diseases***

Plans to contain infectious respiratory diseases need to be strengthened, given the potentially high impact of any outbreaks. Plans need to be supported by a community education programme to raise awareness of how infectious respiratory diseases are transmitted and how they can be contained.

The RMI has implemented sound strategies to limit the introduction of these diseases by international travellers arriving by air, but other strategies are needed to limit spread within the community, if and when an infectious disease arrives. All responsible agencies and relevant parties need to be clearly identified, well informed and coordinated. The experience of other countries during the COVID-19 epidemic is that this tends to be a major weakness. The MOHHS alone cannot prevent the spread of infectious respiratory diseases. Port authorities, educational institutions, retailers, employers and faith-based organizations must also promote and adopt safe practices to limit transmission. Good preventive practices include social distancing, good personal, occupational and environmental hygiene (e.g. handwashing, surface cleaning and disinfection), good ventilation of indoor spaces, face covering in high risk settings (e.g. airport), and ensuring sick leave is taken when required (Vardoulakis et al. 2020c), in addition to the usual MOHHS measures of mass screening and immunization for TB, influenza and pneumonia.

Community education and awareness-raising in schools, faith-based organisations and other community groups and facilities is needed on how infectious respiratory diseases are transmitted within the home as well as within the community. This includes education in the importance of social distancing, proper ventilation and hygiene practices, as well as the need for testing and vaccination. Awareness raising needs to include distinguishing the particular characteristics of the most common respiratory diseases - TB, COVID-19, measles and influenza - as regards risk of transmission and best methods of containment.

### ***Non-communicable respiratory diseases***

Control of non-communicable (i.e. non-infectious) respiratory diseases, such as chronic obstructive pulmonary disease (COPD) and asthma, requires preventive strategies, including education, awareness raising and targeted campaigns on tobacco smoking as well as on air pollution.

Despite on-going education and awareness-raising, tobacco smoking is still common in RMI. A major challenge for any anti-smoking strategy is that the tobacco industry is profitable, so the interests of retailers and advertisers are in conflict with those of health authorities. Imposition of high taxes to increase the price of cigarettes is unlikely to be acceptable to the RMI community and could have the unintended effect of further burdening already low household incomes. A range of strategies is therefore needed to discourage smoking, especially in rural areas where the impact of anti-smoking campaigns and restrictions on smoking in public buildings tends to be weaker.

Air pollution from waste burning, household fuel use, and vehicle emissions can be an underestimated problem. Burning of refuse is a long-established practice in Pacific communities, but the pollution generated has become more severe in recent decades because the refuse burned now includes plastics, rubber and other modern materials that yield toxic fumes. Increased crowding in urban areas has also exacerbated the impact of air pollution from domestic burning of household fuels and vehicle exhausts. The chemicals generated from the combustion of fuel and waste can have a major impact on respiratory health, especially in conjunction with underlying respiratory conditions such as asthma and COPD.

Focus group discussions indicated that there is widespread objection to the practice of generating toxic fumes from burning domestic refuse, and this is perceived as both an anti-social activity and a negative impact on health. At the same time, it was recognised that burning is sometimes the only way of disposing of household refuse. Therefore, regular household waste collection and safe disposal of modern materials by municipal authorities is essential, as well as continuing education in the harmful effects of air pollution.

These actions require coordination between MOHHS, EPA, and municipal services as well as adequate funding to support refuse collection and disposal. This action should be

supported by continuing to educate retailers and communities in urban and rural areas in the need to reduce plastic waste, fuel use, and unnecessary car journeys.

As noted above, if necessary, local regulations concerning litter, waste disposal and pollution should be reviewed and updated to ensure they give sufficient power to local authorities when enforcement is required.

#### **4.7. Extreme weather events**

Preparation to manage health risks associated with advancing climate change and extreme events requires an information base and up-to-date and comprehensive data analysis. This is essential to fully understand the risk profile of natural disaster, heat, floods and droughts, and the planning gaps and needs to formulate effective adaptation policies (Gheuens et al. 2019). Preparedness to extreme weather events is essential in a changing climate. In a climate-vulnerable nation such as the RMI, this needs priority attention.

##### ***Sea level rise and flooding***

Sea level rise, with associated coastal erosion, salination and flooding, is the most pressing climate-related issue for the RMI. Protection against high seas and flooding by the use of physical infrastructure, such as improved sea walls, is a high priority. However, authorities need to be mindful of unintended consequences of potentially accelerated erosion where sea walls have been constructed, and badly built sea walls using rubble. JNAP supports activities under the Food Security and Sustainable Livelihoods Program (FAO) dealing with coastal erosion and enhancing buffer zones.

Timely extreme weather alerts, including projected wave heights when relevant, are recommended. These alerts should include a measure of risk of flooding potential and reach, risk of lens contamination, crop and structural damage, as well as relevant health advice. The Weather Service Office (WSO) system to disseminate weather alerts and related health messages to the entire RMI population must be reliably maintained and tested. Similarly, to assist in preparation and planning at the local level, communities and their leaders need advance notice of long-term forecasts, such as El Niño, and the associated health risks of storms, flooding and droughts.

Consideration should be given to the creation of a position that could straddle the meteorological information as well as disaster planning and health education to ensure seamless knowledge transfer and feedback to the Government, MOHHS and WSO towards preparedness, resilience, and risks communication.

In this context, it is important to initiate, implement and evaluate mechanisms to ensure community wide education of self-protection strategies against extreme weather events. These mechanisms should involve community groups, schools and faith-based organisations, in addition to WSO and MOHHS.

## ***Heat strategies***

Climate change is increasing heat-related health risks globally. Although heat extremes do not occur in RMI, the projected increase in average ambient temperature is a cause for concern and it is prudent for the RMI health sector to prepare. Higher temperatures, coupled with high humidity and other heat risk amplifiers, such as high obesity rates, high population densities and socio-economic disadvantage, place the RMI firmly in the bracket of high heat exposure risk. Relatively simple strategies can be employed to reduce risks of heat related morbidity.

An RMI specific heat-health plan should be developed, modelled on that of other areas with a tropical climate. A key feature of this would comprise a community education strategy that can be disseminated through health clinics to achieve broad reach across the RMI. For example, community members need to be informed of the signs and symptoms of heat stress, so they can recognize it and provide assistance to reduce the risk of heat stress escalating.

Heat stress follows a pattern of cascading seriousness, from mild to serious, with the latter potentially leading to long-term organ damage, or death. Long-term residents of tropical climate are likely to be very familiar with heat coping strategies. Simple first aid strategies can be readily employed at the community level, such as rest, hydration and placing the affected person in the shade or in cool water. However, continued warming is likely to deliver increased heat exposure. Preparedness for increasing heat can assist in preventing related health problems.

Physical exercise increases internal heat generation up to 12-fold. Shedding this additional heat to the external environment is impeded in hot and humid climates, which increases heat gain, and increases the risk of harm. It is important for people to self-assess their own heat, and rest when hot. Perhaps more importantly, others need to listen and not encourage that person to keep moving. A strategy of work-rest periods can reduce heat gain when physical activity, such as outdoor work, is necessary. Other heat protective strategies include shifting the timing of activities to cooler parts of the day.

Heat education campaigns should also include information on population groups at greater risk, such as the aged and people with cardiovascular impairment, the obese, and those who work outside. Providing a summary of early symptoms can assist people to recognise the onset in themselves and others, which can prevent heat risks progressing through to dangerous levels. Dehydration dramatically elevates heat risk, so drinking fluids (not alcohol) is part of the primary first aid treatment and prevention strategy. Heat education campaigns should also include practical advice for reducing the risk of overheating in homes, including improved shading and ventilation.

#### **4.8. Barriers and enablers for implementation**

The NCCHAP (2012) was intended to be the key instrument through which the MOHHS contributed to the RMI JNAP 2014-2018. Specifically, the NCCHAP 2012 was created to address the health goals outlined in the JNAP. Despite its scientific merits, the NCCHAP (2012) did not achieve the intended impacts due to internal and external factors. Importantly, there was no dedicated funding or staff at the MOHHS to implement it, and although there was progress in certain areas, there was no overall coordination, monitoring or reporting.

Therefore, it is important for the NCCHP v2 to be realistic and achievable, with clear actions, responsible agencies, and timescales and costs for delivery. The prioritised actions, responsible agencies, and timescales are presented in Appendix 2. Where possible, the NCCHP v2 indicates plans to generate the necessary funding for the implementation of actions. Costing of the actions is important for facilitating access to climate and health finance, for example through the Green Climate Fund. Furthermore, the NCCHP v2 includes a list of indicators (Appendix 2), which provide a framework for its regular monitoring and evaluation. It is recommended that yearly progress reports be produced over the 5-year implementation period.

The main risks to implementation identified during the consultations with stakeholders include financial, practical, cultural and bureaucratic constraints: (a) insufficient expertise and resources, including lack of dedicated staff, equipment, training and information; (b) complicated transportation logistics for reaching outer islands and unreliable internet and electronic communications; (c) perceived lack of political will and competing priorities; (d) limited engagement of traditional leaders and landowners; and (e) cultural taboos, apathy and stigma in some cases (e.g. mental health issues).

To overcome these risks, it is recommended that an influential and committed “champion” (e.g. MOHHS Deputy Secretary), who will have oversight and responsibility for the action plan, be appointed. Successful implementation also requires dedicated resources and expertise, including a co-ordinating officer who will take care of the day-to-day tasks, coordinate actions, organise regular meetings, collect data, and produce progress reports. Other new and existing resources need to be allocated or re-allocated, as indicated in Appendix 2.

Ministerial endorsement of this policy and action plan is also important for securing funding and buy-in from other Government Departments and Agencies, and overseas donors. Strong engagement with Traditional Leaders and landowners, Local Government, NGOs, and faith-based groups from an early stage is essential for successful implementation. Finally, the NCCHP v2 needs to be embedded in the revised JNAP, as well as in other relevant RMI policies and plans across all sectors.

## 5. Conclusions and recommendations

In a nation vulnerable to climate change and with high prevalence of infectious and non-communicable diseases, actions to protect the population's health from climate change requires priority attention. Preparedness must be proactive, rather than reactive, involve multiple agencies, communities and other stakeholders, such as Traditional Leaders, landowners, NGOs and faith-based organisations. It should also adopt a process of implementation, continuous practice, monitoring, evaluation and updating.

Importantly, the NCCHP v2 needs to be well-coordinated and holistic because of the synergies between actions. For example, food and water safety and security affect susceptibility to infectious disease and NCDs, and physical and mental health affect ability to adapt to and tolerate extreme weather events.

A critical factor for the successful implementation of the action plan is the allocation of new and/or existing resources, and the appointment of a senior "champion" in the MOHHS and of a co-ordinator with overall responsibility for the action plan and its delivery.

Finally, the health considerations reflected in the NCCHP v2 should be integrated into RMI's forthcoming Joint National Adaptation Plan.

## References

- Ahlgren I, Yamada S, Wong A. 2014. Rising oceans, climate change, food aid, and human rights in the marshall islands. *Health and Human Rights* 16:69-80.
- Asugeni J, MacLaren D, Massey PD, Speare R. 2015. Mental health issues from rising sea level in a remote coastal region of the solomon islands: Current and future. *Australasian Psychiatry* 23:22-25.
- Barnett J. 2011. Dangerous climate change in the pacific islands: Food production and food security. *Regional Environmental Change* 11:229-237.
- Blankenship JL, Gwavuya S, Palaniappan U, Alfred J, deBrum F, Erasmus W. 2020. High double burden of child stunting and maternal overweight in the republic of the marshall islands. *Maternal & Child Nutrition* 16:e12832.
- BoM, CSIRO. 2014. Marshall islands. Chapter 7. In: *Climate variability, extremes and change in the western tropical pacific: New science and updated country reports pacific-australia climate change science and adaptation planning program technical report*. Melbourne, Australia: Australian Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organisation, 141-165.
- Bruno JF, Valdivia A. 2016. Coral reef degradation is not correlated with local human population density. *Scientific Reports* 6:29778.
- Canyon DV, Speare R, Burkle FM. 2016. Forecasted impact of climate change on infectious disease and health security in hawaii by 2050. *Disaster Med Public Health Prep* 10:797-804.
- Cauchi JP, Moncada S, Bambrick H, Correa-Velez I. 2020. Coping with environmental hazards and shocks in kiribati: Experiences of climate change by atoll communities in the equatorial pacific. *Environmental Development*:100549.
- Chakraborty R, Khan KM, Dibaba DT, Khan MA, Ahmed A, Islam MZ. 2019. Health implications of drinking water salinity in coastal areas of bangladesh. *International journal of environmental research and public health* 16:3746.
- Cheng L, Abraham J, Hausfather Z, Trenberth KE. 2019. How fast are the oceans warming? *Science* 363:128-129.
- Connell J. 2014. Food security in the island pacific: Is micronesia as far away as ever? *Regional Environmental Change* 15:1299-1311.
- Craig AT, Heywood AE, Hall J. 2020. Risk of covid-19 importation to the pacific islands through global air travel. *Epidemiology and Infection* 148:1-16.
- Crane NL, Nelson P, Abelson A, Precoda K, Rulmal J, Jr., Bernardi G, et al. 2017. Atoll-scale patterns in coral reef community structure: Human signatures on ulithi atoll, micronesia. *PLoS one* 12:e0177083-e0177083.
- CSIRO Aa. 2014. *Climate variability, extremes and change in the western tropical pacific: New science and updated country reports*. (Pacific-Australia Climate Change Science and Adaptation Planning Program Technical Report). Melbourne, Australia: Australian Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organisation.
- Cvitancic C, Crimp S, Fleming A, Bell J, Howden M, Hobday AJ, et al. 2016. Linking adaptation science to action to build food secure pacific island communities. *Climate Risk Management* 11:53-62.
- Dawes N, Franklin R, McIver L, Obed J. 2019. Post-disaster mental health servicing in pacific island communities: An integrative review. *International Journal of Disaster Risk Reduction* 38:101225.
- Descloux E, Mangeas M, Menkes CE, Lengaigne M, Leroy A, Tehei T, et al. 2012. Climate-based models for understanding and forecasting dengue epidemics. *PLOS Neglected Tropical Diseases* 6:e1470.
- Ebi KL, Lewis ND, Corvalan C. 2006. Climate variability and change and their potential health effects in small island states: Information for adaptation planning in the health sector. *Environmental health perspectives* 114:1957-1963.
- Filho WL, Scheday S, Boenecke J, Gogoi A, Maharaj A, Korovou S. 2019. Climate change, health and mosquito-borne diseases: Trends and implications to the pacific region. *International journal of environmental research and public health* 16:5114.
- Friedman MA. 2008. Ciguatera fish poisoning: Treatment, prevention and management. *Marine Drugs* 6:456-479.

- Gesch D, Palaseanu-Lovejoy M, Danielson J, Fletcher C, Kottermair M, Barbee M, et al. 2020. Inundation exposure assessment for majuro atoll, republic of the marshall islands using a high-accuracy digital elevation model. *Remote Sensing* 12:154.
- GFDRR. 2017. *Sisri knowledge notes: The small island states resilience initiative*. Washington DC:World Bank and Global Facility for Disaster Reduction and Recovery.
- Gheuens J, Nagabhatla N, Perera EDP. 2019. Disaster-risk, water security challenges and strategies in small island developing states (sids). *Water* 11:637.
- Gibson K, Haslam N, Kaplan I. 2019. Distressing encounters in the context of climate change: Idioms of distress, determinants, and responses to distress in tuvalu. *Transcult Psychiatry* 56:667-696.
- Gibson KE, Barnett J, Haslam N, Kaplan I. 2020. The mental health impacts of climate change: Findings from a pacific island atoll nation. *Journal of Anxiety Disorders* 73:102237.
- Gingerich SB, Voss CI, Johnson AG. 2017. Seawater-flooding events and impact on freshwater lenses of low-lying islands: Controlling factors, basic management and mitigation. *Journal of Hydrology* 551:676-688.
- Guernier V, Goarant C, Benschop J, Lau CL. 2018. A systematic review of human and animal leptospirosis in the pacific islands reveals pathogen and reservoir diversity. *PLOS Neglected Tropical Diseases* 12:e0006503.
- Hanna EG, Tait PW. 2015. Limitations to thermoregulation and acclimatization challenge human adaptation to global warming. *International Journal of Environmental Research and Public Health* 12:8034-8074.
- Helland L, Walkover M. 2018. Mental health, climate change, and community development: Strengthening core capabilities to promote community resilience. (Community Development Innovation Review). University of Hawaii-Manoa and California Department of Public Health.
- Hoegh-Guldberg O, Poloczanska ES, Skirving W, Dove S. 2017. Coral reef ecosystems under climate change and ocean acidification. *Frontiers in Marine Science* 4.
- Hoy D, Roth A, Lepers C, Durham J, Bell J, Durand A, et al. 2014. Adapting to the health impacts of climate change in a sustainable manner. *Globalization and Health* 10:82.
- Ibell C, Sheridan SA, Hill PS, Tasserei J, Maleb MF, Rory JJ. 2015. The individual, the government and the global community: Sharing responsibility for health post-2015 in vanuatu, a small island developing state. *International Journal for Equity in Health* 14:13.
- IPCC. 2012. *Managing the risks of extreme events and disasters to advance climate change adaptation. A special report of working groups i and ii of the intergovernmental panel on climate change*. Cambridge, UK, and New York, NY, USA.
- Jenkins A, Horwitz P, Arabena K. 2018. My island home: Place-based integration of conservation and public health in oceania. *Environmental Conservation* 45:125-136.
- Kakuma R, Minas H, van Ginneken N, Dal Poz MR, Desiraju K, Morris JE, et al. 2011. Human resources for mental health care: Current situation and strategies for action. *Lancet* 378:1654-1663.
- Keener V, Marra J, Finucane M, Spooner D, Smith M. 2012. Climate change and pacific islands: Indicators and impacts, report for the 2012 pacific islands regional climate assessment (pirca).
- Kingsley J, Patrick R, Horwitz P, Parkes M, Jenkins A, Massy C, et al. 2015. Exploring ecosystems and health by shifting to a regional focus: Perspectives from the oceania ecohealth chapter. *International journal of environmental research and public health* 12:12706-12722.
- Knutson TR, McBride JL, Chan J, Emanuel K, Holland G, Landsea C, et al. 2010. Tropical cyclones and climate change. *Nature Geosci* 3:157-163.
- Kool JL, Paterson B, Pavlin BI, Durrheim D, Musto J, Kolbe A. 2012. Pacific-wide simplified syndromic surveillance for early warning of outbreaks. *Global public health* 7:670-681.
- Lal A, Lucas RM, Slatyer A. 2020. Water access as a required public health intervention to fight covid-19 in the pacific islands. *The Lancet Regional Health - Western Pacific* 1:100006.
- Lau CL, Watson CH, Lowry JH, David MC, Craig SB, Wynwood SJ, et al. 2016. Human leptospirosis infection in fiji: An eco-epidemiological approach to identifying risk factors and environmental drivers for transmission. *PLOS Neglected Tropical Diseases* 10:e0004405.
- Lohmann P, Pondorfer A, Rehdanz K. 2019. Natural hazards and well-being in a small-scale island society. *Ecological Economics* 159:344-353.
- MacDonald MC, Elliott M, Langidrik D, Chan T, Saunders A, Stewart-Koster B, et al. 2020. Mitigating drought impacts in remote island atolls with traditional water usage behaviors and modern technology. *Science of The Total Environment* 741:140230.

- Magnan AK, Garschagen M, Gattuso J-P, Hay JE, Hilmi N, Holland E, et al. 2019. Cross-chapter box 9: Integrative cross-chapter box on low-lying islands and coasts. (IPCC Special Report on the Ocean and Cryosphere in a Changing Climate).
- Marra JJ, Kruk MC, Abecassis M, Diamond H, Genz A, Heron SF, et al. 2017. State of environmental conditions in hawaii and the u.S. Affiliated pacific islands under a changing climate: 2017. NOAA NCEI.
- Masuda YJ, Castro B, Aggraeni I, Wolff NH, Ebi K, Garg T, et al. 2019. How are healthy, working populations affected by increasing temperatures in the tropics? Implications for climate change adaptation policies. *Global Environmental Change* 56:29-40.
- McCubbin SG, Pearce T, Ford JD, Smit B. 2017. Social&#8211;ecological change and implications for food security in funafuti, tuvalu. *Ecology and Society* 22.
- Mclver L, Woodward A, Davies S, Tibwe T, Iddings S. 2014. Assessment of the health impacts of climate change in kiribati. *International journal of environmental research and public health* 11:5224-5240.
- Mclver L, Kim R, Woodward A, Hales S, Spickett J, Katscherian D, et al. 2016. Health impacts of climate change in pacific island countries: A regional assessment of vulnerabilities and adaptation priorities. *Environ Health Perspect* 124:1707-1714.
- Mclver L, Bowen K, Hanna E, Iddings S. 2017. A 'healthy islands' framework for climate change in the pacific. *Health Promot Int* 32:549-557.
- Mei Y, Hu J. 2020. Preparedness is essential for western pacific islands during the covid-19 pandemic. *Disaster medicine and public health preparedness*:1-5.
- Miller J. 2019. Indigenous design knowledge and placemaking in the climate diaspora. (ARCC Conference Repository: The Future of Praxis: Applied Research as a Bridge Between Theory and Practice).
- Mirsaeidi M, Motahari H, Taghizadeh Khamesi M, Sharifi A, Campos M, Schraufnagel DE. 2016. Climate change and respiratory infections. *Ann Am Thorac Soc* 13:1223-1230.
- Nguyen-Truong CKY, Leung J, Micky K. 2020. Cultural narratives of micronesia islander parent leaders: Maternal and children's health, the school system, and the role of culture. *Asian Pac Isl Nurs J* 4:173-182.
- Nurse LA, McLean RF, Agard J, Briguglio LP, Duvat-Magnan V, Pelesikoti N, et al. 2014a. Small islands. In: *Climate change 2014: Impacts, adaptation, and vulnerability. Part b: Regional aspects. Contribution of working group ii to the fifth assessment report of the intergovernmental panel on climate change.* Cambridge, United Kingdom and New York, NY, USA.
- Nurse LA, McLean RF, Agard J, Briguglio LP, Duvat-Magnan V, Pelesikoti N, et al. 2014b. Small islands. (Climate Change 2014: Impacts, Adaptation, and Vulnerability Part B: Regional Aspects Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change). Cambridge, United Kingdom and New York, NY, USA:Cambridge University Press.
- Obradovich N, Migliorini R, Paulus MP, Rahwan I. 2018. Empirical evidence of mental health risks posed by climate change. *Proceedings of the National Academy of Sciences* 115:10953-10958.
- Pries AM, Filteau S, Ferguson EL. 2019. Snack food and beverage consumption and young child nutrition in low- and middle-income countries: A systematic review. *Matern Child Nutr* 15 Suppl 4:e12729.
- Puotinen M, Drost E, Lowe R, Depczynski M, Radford B, Heyward A, et al. 2020. Towards modelling the future risk of cyclone wave damage to the world's coral reefs. *Glob Chang Biol On line* May 27th: DOI: 10.1111/gcb.15136
- Republic of the Marshall Islands. 2019. Disaster management reference handbook 2019.
- RMI. 2012. National climate change and health action plan. Republic of the Marshall Islands Ministry of Health.
- RMI. 2013. Republic of the marshall islands food security policy.
- RMI. 2014. Republic of the marshall islands joint national action plan for climate change adaptation & disaster risk management 2014-2018.
- RMI. 2017. 3 year rolling strategic plan 2017-2019. Republic of Marshall Islands.
- RMI. 2018. Tile til eo 2050 climate strategy "lighting the way". Republic of Marshall Islands.
- RMI. 2019a. The republic of the marshall islands: Disaster management reference handbook 2019.
- RMI. 2019b. Nitijela of the republic of the marshall islands 40th constitution regular session: National climate crises as the low-lying coral atoll nation. Resolution 83.
- Rongo T, van Woesik R. 2013. The effects of natural disturbances, reef state, and herbivorous fish densities on ciguatera poisoning in rarotonga, southern cook islands. *Toxicon* 64:87-95.

- Sarfati D, Dyer R, Sam FA, Barton M, Bray F, Buadromo E, et al. 2019. Cancer control in the pacific: Big challenges facing small island states. *Lancet Oncol* 20:e475-e492.
- Savage A, McIver L, Schubert L. 2020a. Review: The nexus of climate change, food and nutrition security and diet-related non-communicable diseases in pacific island countries and territories. *Climate and Development* 12:120-133.
- Savage A, Schubert L, Huber C, Bambrick H, Hall N, Bellotti B. 2020b. Adaptation to the climate crisis: Opportunities for food and nutrition security and health in a pacific small island state. *Weather, Climate, and Society* 12:745-758.
- Sharp TM, Mackay AJ, Santiago GA, Hunsperger E, Nilles EJ, Perez-Padilla J, et al. 2014. Characteristics of a dengue outbreak in a remote pacific island chain--republic of the marshall islands, 2011-2012. *PLoS one* 9:e108445-e108445.
- Singh RB, Hales S, de Wet N, Raj R, Hearnden M, Weinstein P. 2001. The influence of climate variation and change on diarrheal disease in the pacific islands. *Environmental health perspectives* 109:155-159.
- Skinner MP, Brewer TD, Johnstone R, Fleming LE, Lewis RJ. 2011. Ciguatera fish poisoning in the pacific islands (1998 to 2008). *PLoS Neglected Tropical Diseases* 5:e1416.
- Skuse D. 2018. Mental health and life on a small island. *BJPsych international* 15:27-27.
- Smith G, Juria N. 2019. Diagnosis of historical inundation events in the marshall islands to assist early warning systems. *Natural Hazards* 99:189-216.
- Smith R. 2019. Options and choices in relation to adopting healthy lifestyles in the pacific islands region. *Journal of Developing Societies* 35:62-82.
- Storlazzi CD, Gingerich SB, van Dongeren A, Cheriton OM, Swarzenski PW, Quataert E, et al. 2018a. Most atolls will be uninhabitable by the mid-21st century because of sea-level rise exacerbating wave-driven flooding. *Science Advances* 4:eaap9741. DOI: 9710.1126/sciadv.aap9741
- Storlazzi CD, Gingerich SB, van Dongeren A, Cheriton OM, Swarzenski PW, Quataert E, et al. 2018b. Most atolls will be uninhabitable by the mid-21st century because of sea-level rise exacerbating wave-driven flooding. *Science Advances* 4:eaap9741.
- Tang HY. 2017. Poverty in the marshall islands: The borgen project. USA.
- Togami E, Kama M, Goarant C, Craig SB, Lau C, Ritter JM, et al. 2018. A large leptospirosis outbreak following successive severe floods in fiji, 2012. *Am J Trop Med Hyg* 99:849-851.
- van der Geest K, Burkett M, Fitzpatrick J, Stege M, Wheeler B. 2020. Climate change, ecosystem services and migration in the marshall islands: Are they related? *Climatic Change* 161:109-127.
- Vardoulakis S, Hanna L, McMurray C. 2020a. Consultancy to prepare a national climate change and health policy (ncchp) and revised action plan for the republic of marshall islands. D4. Qualitative assessment of achievements of ncchp 2012. Australian National University.
- Vardoulakis S, Joshy A, McIver L. 2020b. Consultancy to prepare a national climate change and health policy (ncchp) and revised action plan for the republic of marshall islands. D2. Desktop review. Australian National University.
- Vardoulakis S, McMurray C. 2020. Consultancy to prepare a national climate change and health policy (ncchp) and revised action plan for the republic of marshall islands. D5. Consultations and mapping workshop with list of stakeholders. Australian National University.
- Vardoulakis S, Sheel M, Lal A, Gray D. 2020c. Covid-19 environmental transmission and preventive public health measures. *Australian and New Zealand Journal of Public Health* 44:333-335.
- WHO. 2015a. Human health and climate change in pacific island countries. Manila, Philippines:World Health Organization, Western Pacific Regional Office.
- WHO. 2015b. Operational framework for building climate resilient health systems. 9789241565073. Geneva:World Health Organization.
- WHO. 2017. Who country cooperation strategy 2018-2022: Marshall islands. Manila, Philippines:World Health Organization. Regional Office for the Western Pacific.
- WHO. 2018. Climate change and health in small island developing states: A who special initiative, pacific island countries and areas. 9789290618669. World Health Organization. Regional Office for the Western Pacific.
- WMO. 2020. Wmo statement on the state of the global climate in 2019. Geneva:World Meteorological Organization.

Yamada S, Riklon S, Maskarinec GG. 2016. Ethical responsibility for the social production of tuberculosis. *J Bioeth Inq* 13:57-64.

Zahlawi T, Roome AB, Chan CW, Campbell JJ, Tosiro B, Malanga M, et al. 2019. Psychosocial support during displacement due to a natural disaster: Relationships with distress in a lower-middle income country. *International Health* 11:472-479.

# Appendix 1: Circulation List

## RMI Government & Agencies

- Ministry of Health and Human Services (MOHHS)
- Office of the Chief Secretary (OCS)
- Office of the Chief Secretary (OCS) – Ebeye
- Office of Environment Planning and Policy Coordination (OEPPC)
- RMI Climate Change Directorate (CCD)
- Marshall Islands Marine Resources Authority (MIMRA)
- Ministry of Culture and Internal Affairs (MOCIA)
- Ministry of Natural Resources and Commerce (NRC) - Agriculture Division
- National Telecommunication Authority (NTA)
- Kio Club/National Energy Office
- RMI Youth Services Bureau
- Environmental Protection Authority (EPA)
- Office of Commerce, Investment & Tourism (OCIT)
- Weather Service Office (WSO)
- Economic Policy, Planning and Statistics Office (EPPSO)
- Marshall Islands National Disaster Management Office (NDMO)
- Tile Til Eo Committee (TTEC)

## Local Authorities

- Majuro Atoll Local Government (MALGov)
- Delap Council
- Laura Lolap Council
- Laura Lomar Council
- Lobat Council
- Rita Council
- Rita Council
- Rairok Council
- Woja Council
- MIMA / Namo Mayor
- KBE Mayor
- Likiep Council
- Wotho Mayor
- Ebon Mayor
- Jaluit Mayor

## **Traditional Leaders & Landowners**

- Council of Iroij

## **Business Sector**

- Chamber of Commerce
- Majuro Atoll Waste Company (MAWC)
- Majuro Water and Sewer Company (MWSC)
- Tobolar Copra Processing Plant
- Marshall Islands (MI) Handicraft Group
- Taiwan Farm / Taiwan Technical Mission

## **Non-Profit Organisations**

- College of the Marshall Islands (CMI)
- Enemanit-Latuma Extended Family Association (ELEFA) - Bikini Conservation Group
- Marshall Islands Conservation Society (MICS)
- Marshall Islands Epidemiology & Prevention Initiatives (MIEPI)
- Marshall Islands Council of Non-Governmental Organizations (MICNGOs)
- Red Cross
- Waan Aelon in Majel (WAM) - Canoes of the Marshall Islands Program
- Youth to Youth in Health (YTYIH)
- Women United Together Marshall Islands (WUTMI)
- Jo-Jikum (Marshall Islands Youth and Climate Organisation)
- Canvasback Wellness Center
- MI Organic Farmers Association
- Reach-MI – NGO for addressing unresolved nuclear issues in Marshall Islands
- Kora in Jiban Lolorjake Ejmour (KIJLE) – NGO promoting weight loss and improved health
- Jined (“our mothers”) Club – NGO promoting lives & livelihoods of women and families
- Womens Athletic Co.
- Taiwan Health Center
- Chinese Association
- Billfish/Urok Club
- Kumit Bobrae Coalition (alcohol, tobacco and drugs-free coalition)
- Law Association
- Research and Education Community Organization (RECO) RMI

- Waan Aelon in Majel (WAM) - Canoes of the Marshall Islands Program
- Faith Based Organisations / Church Leaders
- Assembly of God Church
- Marshall Islands Organic Farmers Association (MIOFA)
- Land Grant Program
- Salvation Army

### **International / Academic Organisations**

- World Health Organization (WHO, North Pacific Office)
- International Office of Migration
- University of South Pacific (USP)
- Australian National University (ANU)

## Appendix 2: Action Matrix

Health Issue	Priority (High/Medium/Low)	Action(s) needed	Lead agency, Supporting agency	Indicator (KPI)
<b>Food Safety &amp; Security</b>	High	<p>Improve agricultural practices to increase local food production:</p> <ul style="list-style-type: none"> <li>• Introduction of more drought resistant crops;</li> <li>• Better techniques for preservation and storage of crops;</li> <li>• Adoption of more water-efficient techniques for growing crops;</li> <li>• Replanting traditional foodstuffs.</li> </ul>	<p>MNRC</p> <p>MOHHS, Central Statistics Office (CSO), NDMO, MOCIA, CCD, MICNGOs</p>	<p>Number of community/island development plans including sustainable agricultural practices.</p> <p>Number of drought resistant crops established.</p> <p>Number of new irrigation systems installed.</p>
	High	<p>Increase outreach and awareness raising in sustainable agricultural techniques, including irrigation (wicking) systems for crop growing, pest control, use of non-chemical fertilisers.</p>	<p>MNRC</p> <p>MOHHS, Wellness Center, Local Resources Committee (LRC)</p>	<p>Awareness raising campaign for sustainable agricultural practices.</p>
	Low	<p>Investigate local production and benefits of traditional medicines.</p>	<p>MNRC</p> <p>MOHHS, Local Government, Traditional Leadership, Faith-based organisations, CMI / USP</p>	<p>Study into benefits of traditional medicines.</p>
	Medium	<p>Improve advance weather forecasts and associated advice for agricultural practices.</p>	<p>WSO</p> <p>EPA, CCD</p>	<p>Daily weather forecasts with related advice for farmers.</p>

Health Issue	Priority (High/Medium/Low)	Action(s) needed	Lead agency, Supporting agency	Indicator (KPI)
	Medium	Reduce Ciguatera occurrences: <ul style="list-style-type: none"> <li>• Continue community education, for example via posters;</li> <li>• Expand conservation areas to restrict fishing in ciguatera hotspots.</li> </ul>	MIMRA  NGOs, Local Government, Traditional Leadership	Number of ciguatera poisoning cases per year.
<b>Water Safety &amp; Security</b>	High	Increase water quality testing and data collection on drinking water supplies, and community access to safe water in outer islands.	EPA  Majuro Water and Sewer Company (MWSC), Local Government, MOHHS	Number of water quality tests conducted per island per year.
	High	Engage with communities to raise awareness about water-related health risks. Prepare educational materials on clean drinking water, sanitation and hygiene.	MOHSS  Local Government, MNRC, EPA, Traditional Leadership, Faith-based organisations	Online and printed resources for public health education on water-related health risks.
	High	Increase community rainwater harvesting systems.	Local Government  MNRC, EPA, MWSC	Number of community rainwater harvesting systems installed.
	High	Enforce existing water regulations and develop a national plan for water, co-ordinated by a National Water Office.	EPA  MNRC, MOHHS, Attorney General's Office	National plan for water developed.
<b>Vector-Borne Diseases</b>	High	Continue community education and awareness raising about vector borne	MOHHS  MICNGOs, Traditional Leadership, Faith-based	Online and printed resources for public

Health Issue	Priority (High/Medium/Low)	Action(s) needed	Lead agency, Supporting agency	Indicator (KPI)
		diseases and the importance of eliminating mosquito breeding sites.	organisations, Public School Services.	health education on vector-borne diseases.
	High	Promote behavioural changes in retailers and communities to reduce waste and promote recycling. Increase access to these facilities for the community. Reduce plastic waste, waste burning, domestic fuel use, and unnecessary car journeys.	Local Government  NRC, EPA, Traditional Leadership, Public School Service, MICNGOs, Faith based organisations	Number of accessible recycling and waste disposal facilities.
	High	Improved municipal services as well as adequate funding to support refuse collection and disposal.	Municipal waste services  EPA, MOHHS	Quantity of waste that goes into dump / burning.
	High	Review and enforce regulations concerning litter, storage of waste, reduce burning, and pollution control.	EPA  Local Government, Attorney General's Office	Up-to-date regulations on waste management and pollution control.
	High	Increase the capacity for vector control beyond Majuro Atoll. This involves providing staff, equipment and transport.	MOHHS  Local Government	Number of Environmental Health staff working on vector eradication across RMI.
	Medium	Engage with landowners and church leaders for coordinated community clean up.	Local Government  Traditional Leadership, Faith-based organisations, EPA, MOHHS	Clean-ups Coordination and Liaison Officer employed.

Health Issue	Priority (High/Medium/Low)	Action(s) needed	Lead agency, Supporting agency	Indicator (KPI)
<b>Non-Communicable Diseases</b>	High	Raise awareness in schools and communities about healthy nutrition. This includes providing information on the importance of a balanced diet, avoidance of foods high in salt, fats and sugar, and restricting alcohol intake.	MOHHS  Public School Services / CMI / USP, MICNGOs, Faith-based organisations, Traditional Leadership	Awareness raising campaign on healthy diet targeting households and food outlets.
	High	Promote and raise awareness of the importance of physical activity for men and women of all ages and abilities.	MOHHS  MICNGOs, Faith-based organisations, Traditional Leadership, Public School Services	Number of community sports programmes for males and females of all ages.
	High	Increase the availability of facilities for sport and exercise for all, including air-conditioned spaces in offices and public buildings.	MOHHS  Local Government, Public School Services, MICNGOS	Number of indoor facilities available for sport and exercise.
	High	Provide safe and well-lit walkways and cycle lanes in Majuro to promote active travel (i.e. walking and cycling). Encouraging the formation of bike sharing schemes and clubs for various age groups.	Local Government  MPW, MOHHS, Traditional Leadership, Faith-based organisations, Public School Services, MICNGOS	Length of safe/well-lit walkways and cycle lanes. Number of communal bike sharing schemes.
	Medium	Creation of safe swimming areas and introduction of swimming lessons, lap training and water aerobics for men and women of all ages.	MOHHS  Local Government, Traditional Leadership, MICNGOS	Number of safe swimming areas. Number of swimming learning programmes.

Health Issue	Priority (High/Medium/Low)	Action(s) needed	Lead agency, Supporting agency	Indicator (KPI)
<b>Mental Health and Well-Being</b>	High	Review health system facilities and resources in relation to mental health in RMI, as well as of traditional / community-led initiatives.	MOHHS  RMI Mental Health Advisory Council, Public School Services / CMI / USP, MICNGOS	Review of existing facilities and resources for mental health services provision.
	High	School education and community awareness raising in the causes and nature of mental stress and associated mental health problems, including exacerbation by climate change.	MOHHS  RMI Mental Health Advisory Council, Public School Services / CMI / USP, MICNGOs, Faith-based organisations	Number of awareness raising campaigns and school programs on mental health and wellbeing.
	High	Increased availability of trained mental health professionals and facilities (e.g. mental health helpline) to ensure sufficient and adequate mental health services.	MOHHS  MICNGOS	Number of psychiatric nurses, psychologists and psychiatrists employed. Establishment of a mental health helpline.
	High	In-service training for health professionals on outer islands and atolls to raise awareness of the likely impact of climate change on mental health.	MOHHS	Number of trained staff on outer islands.
<b>Respiratory diseases</b>	High	Up-to-date emergency plan for infectious disease outbreaks, including provision for border closures, mass screening, and mass vaccinations	Cabinet  MOHSS, MOFA, MICNGOs, CSO	Up-to-date infectious disease outbreak emergency plan. Screening programmes for TB and COVID-19. Measles/ Influenza vaccination coverage.

Health Issue	Priority (High/Medium/Low)	Action(s) needed	Lead agency, Supporting agency	Indicator (KPI)
	High	Community education and awareness-raising in schools, faith-based organisations and other community groups on how infectious respiratory diseases are transmitted within the home as well as within the community, and on related preventive measures.	MOHHS  Public School Services, MICNGOs	Awareness raising campaign on infectious respiratory illnesses.
	High	Community education and awareness-raising in schools, faith-based organisations and other community groups to discourage smoking, especially in rural areas.	MOHHS Public School Services, MICNGOs, Faith-based organisations	Anti-smoking campaign covering rural areas and remote islands.
<b>Extreme weather events</b>	High	Timely extreme weather alerts, including projected wave heights when relevant. Alerts should include risk for flooding potential and reach, risk of lens contamination, crop and structural damage.	MOHHS  NDMO, WSO, NTA	Creation of joint MOHHS and WSO staff position.
	High	Community education and practical health protection advice to prevent injury, and food and water contamination from floods. Assessment of resources required to equip citizens to self-protect in place.	MOHHS  NDMO, MICNGOs, Faith-based organisations	Educational campaign to raise awareness of extreme weather events and related health protection.
	Medium	Heat-health plan including community education that can be disseminated through health clinics to achieve broad reach across the RMI.	MOHHS  WSO, CCD	Heat-health plan and educational campaign.