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Climate Change and Health:
A Security Challenge in the Pacific Islands

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Abstract

Physical and mental health in Pacific Island Countries is particularly vulnerable to climate change, both directly, as an outcome of temperature increases and hazards, and indirectly, through increased threats to livelihoods. Higher temperatures extend the risk of malaria and dengue spreading southwards. Urban heat islands boost respiratory diseases. New vector-borne diseases, including zika and chikungunya, have become more frequent. Cyclones and floods, especially in densely populated coastal areas, result in injuries, damage to health facilities and more vulnerable ecosystems and livelihoods, particularly affecting marine productivity, as ocean temperatures increase. Droughts put occasional pressure on water and food security, worsening epidemics of existing non-communicable diseases (NCDs). Poorer mental health is partly a function of climate anxiety. Health services are poorly equipped to cope with new pressures. Those living on atolls and in overcrowded urban settlements are the most vulnerable. The health impacts of climate change constitute a slowly increasing threat to human security, but policies and practices centred on workforce development may minimise such threats and risks.

Introduction

Climate change will negatively impact physical and mental health in Pacific Island Countries (PICs), which are among the countries most vulnerable to its health impacts (McIver et al. 2016, WHO 2015a, Asian Development Bank 2017). Moreover, it places additional burdens on poorly equipped and resourced health care sectors. As the WHO has observed: ‘Climate

change is one of the defining challenges of our time and probably constitutes one of the most significant global health threats of the 21st century' (WHO 2015a: 135). Numerous articles consistently point to emerging problems in the region (Haines et al. 2006, Hashim and Hashim 2016, Bambrick 2018, Filho et al. 2019, Voyatzis-Bouillard and Kelman 2021, Kim et al. 2022, Palinkas et al. 2022). These may be both direct (such as injuries sustained in intense cyclones, and the spread of diseases into now warmer regions) or indirect (through impacts on socio-economic development that then affect health). They may also have delayed effects (such as disruptions to health and social services). Extremely hot days occur more often than they used to, and warming trends are happening everywhere, at all times of the year. Without mitigation and a reduction in the rate of climate change these impacts are likely to become more frequent and intense, particularly affecting countries whose health status is generally poor (WHO 2015a). Even before the COVID-19 crisis in the region, and the increased evidence of climate change impacts on health, alongside stagnating or declining life expectancy rates, the detrimental impact of health on livelihoods was increasingly perceived as a threat to security (Thomson 2021), further made manifest during the COVID-19 pandemic.

Climate change is a multiplier to existing health problems, which will exacerbate disparities in health. Frequent severe weather events, rising sea levels, and warming sea temperatures affect communities and their food and water sources, and increase the risk of spread of vector-borne diseases such as dengue fever, as well as other water-borne diseases such as diarrhoea. Growing urban areas will have intensified 'heat islands', exacerbated by environmental degradation and greater population density, with the probable outcome of worsened respiratory diseases. Damage to health facilities may reduce access to health care.

While PIC leaders have focused on the economic, environmental and political effects of climate change, little high-level attention has yet been given to policy and advocacy over the health effects of the climate crisis, despite its threat to human and national security (Tukuitonga and Vivili 2021). This Policy Brief discusses, and provides an overview of, the direct impacts of climate change on health in the PICs, notes that there are equally significant but better understood indirect impacts, and concludes with suggestions and recommendations for policy directions.

Temperature Increases

Climate change affects urban environments, both outside, where higher temperatures, especially in urban heat islands, increase stress and morbidity, but also indoors, where relative humidity increases. Urbanisation at higher densities with greater fuel and vehicle use intensifies the heat island effect and increases air pollution. Respiratory diseases such as asthma and bronchitis, presently significant in many Pacific urban areas, may become even more pressing.

Heat waves can cause direct effects such as dehydration, heat exhaustion, and heat stroke. Indirectly, exposure to extreme heat may exacerbate existing conditions, such as cardiovascular diseases, and introduce new challenges to the control of infectious diseases. Climate-related ecosystem changes can increase the range, seasonality, and infectiousness

of many diseases, including cholera and diarrhoeal diseases, as well as malaria and dengue, that are highly sensitive to both temperature and rainfall. More than half of all infectious vector-borne diseases are aggravated by both climatic hazards and increased temperatures.

Malaria is endemic to equatorial regions, and in the Pacific is spreading southwards as temperatures increase. Thus, in Vanuatu, malaria is endemic on Ambae island, but not on the southern island of Futuna. It is prevalent in tropical and subtropical regions, particularly in Solomon Islands and Papua New Guinea (PNG), because of rainfall, consistent high temperatures and high humidity, along with the presence of stagnant water where mosquito larvae mature. Substantial efforts to eliminate malaria have taken place but reaching the more vulnerable and often inaccessible populations has proved difficult. Malaria was nearly eradicated in the Pacific in the 1970s, but progress has stalled in recent years. Vanuatu was moving closer to eradication (and in 2014 claimed that it would be vanquished by 2020), before an outbreak in 2022, in the islands of Santo, Malakula, Epi and Vanua Lava. Malaria had previously been successfully eliminated from Tafea province in 2017, and Torba and Penama provinces had experienced two years with no reported cases. The Ministry of Health concluded that: 'Experience from other countries approaching malaria elimination is that if efforts are interrupted, malaria can quickly rebound back to high levels … because there is no immunity against malaria (with no vaccine available), health workers are unfamiliar with the disease, treatment may not be available or prescribed appropriately, and there is complacency to finish treatment' (Radio New Zealand, 2022). Significantly, the new outbreak coincided with attention being focused on COVID-19.

Solomon Islands has also made progress in malaria vector control, alongside improved diagnostics and therapeutic drugs, but it remains present, while in PNG malaria is centred in several coastal and islands provinces, although becoming more prevalent in highlands areas with increased socio-economic mobility between coast and highlands (Russell et al. 2021, Seidahmed et al. 2022). Throughout Melanesia, malaria is highly heterogeneous, between and within geographical regions, which makes control and eradication particularly difficult. Efforts to eliminate the disease compete with climate change resulting in its spread.

Dengue is an arboviral disease spreading globally, with most outbreaks being reported in the western Pacific. It is highly sensitive to climatic conditions, especially temperature, rainfall and relative humidity, hence it is clearly linked to climate change, with its incidence in the Pacific correlated with rising temperatures, and even more so with El Niño/Southern Oscillation (ENSO) events (Hales et al. 1999, WHO 2015a). Dengue is a flu-like illness with high fever, headaches and pain, and no known cure. It has intermittently circulated in the Pacific since the late nineteenth century, but seemed absent until the 1970s when it returned with several outbreaks. Recently, there has been an increase in the number of cases reported from the Solomon Islands, Vanuatu, Fiji and Palau (Roth et al. 2014). Rising temperatures, longer wet seasons, and increased urbanisation (with overcrowding presenting environmental risk factors for vector breeding and transmission) have all contributed to the spread of dengue and other vector-borne diseases (Getahun et al. 2019). Both dengue and malaria are moving southwards in the Pacific as temperature increases, spreading amongst the Melanesian population of the Torres Strait islands (Connell 2023). Water–borne diseases such as cholera could also spread more quickly and occur further south (Nelson et al. 2022).

In this century, newer vector-borne arbovirus diseases have increasingly been detected in the Pacific. In addition to malaria and dengue, zika and chikungunya outbreaks have been documented and all are increasing in the region, as mosquitoes spread and adapt. Zika was first reported in the Pacific in 2007 (in Yap, FSM) and chikungunya in New Caledonia in 2011, but in the 2010s both spread much further with some massive outbreaks (Saretzki et al. 2022, Russell et al. 2022). In the aftermath of the 2015 global pandemic of zika, it was detected in the Cook Islands, Vanuatu, Fiji, Samoa, Solomon Islands, Tonga and American Samoa. Similar diseases have also entered and spread through the region. Leptospirosis—mainly transmitted through animals with an incidence correlated with hot and rainy conditions, and especially floods—has entered the region. Despite its being widespread, the pattern and process of this spreading has not been documented and knowledge over risk factors and transmission routes is also limited (Guernier et al. 2018, Bouscaren et al. 2019). Within the Pacific and globally, the geographical and numerical incidence of this trilogy of 'new' diseases—leptospirosis, zika and chikungunya—along with dengue, has increased in this century and is likely to continue to do so (Ryan et al. 2021). Dengue and Ross River Virus (closely related to chikungunya and endemic to Australia, where climate change is also encouraging its southwards spread (Connell 2023)), were the only mosquito-borne viruses known to circulate in the Pacific until the recent emergence of zika and chikungunya. Local and regional transmission follows the presence of competent mosquito vectors.

However, relationships between temperature increases and changing disease patterns are complex and they challenge prediction; several changes in incidence and severity are likely, at least in part, to be the outcome of socio-economic changes and structures of service delivery. Beyond diseases, increased heat may simply reduce the productivity of work in already tropical island environments. Samoan farmers, for example, have stated that they worked shorter hours because of increased temperatures (Cassinat et al. 2022), with two consequences: reduced production and productivity in vulnerable populations, and greater sedentarism and thus a greater probability of NCDs.

Moreover, climate change and temperature increases are also likely to exacerbate susceptibility to TB by increasing the prevalence of its underlying risk factors: HIV infection, diabetes mellitus, undernutrition, overcrowding and poverty (Kharwadkar et al. 2022). Health impacts of heatwaves are also indirect. More frequent marine heatwaves may kill off coastal fish species and promote the growth of harmful algae blooms, with negative impacts on food security, tourism, and thus the local economy and human health. Fisheries—both for subsistence and commercial sales—are most likely to be affected by changed water temperatures, ocean acidification and oxygen concentration that will reduce the productivity of reefs (especially should bleaching occur), stress the less mobile invertebrates (such as sea cucumbers) and result in the migration of commercial tuna species eastwards to distant waters beyond PIC exclusive economic zones (Giddens et al. 2022). This will occur alongside increased coastal fishing and coastal pollution, further disrupting mangrove and reef habitats, and thus reducing the productivity of coastal ecosystems (Connell 2013, Golden et al. 2016, McFarlane et al. 2019, Crimp et al. 2021).

The impact of climate change on health has parallels in the negative impact of human activity on reefs. Destruction of reefs by either climate change-induced natural factors, such

as storms and bleaching or anthropogenic influences such as blasting, dredging work, construction of ports and piers and eutrophication, have led to denuded and damaged surfaces being colonised by opportunistic macro-algae that are the hosts for the dinoflagellates responsible for a growing incidence of ciguatera (a foodborne illness caused by eating reef fish whose flesh is contaminated), whose distribution and growth appears to be influenced by abrupt stresses (such as cyclones and storms) or gradual stresses (increasing sea surface temperature, salinity, and nutrient concentrations) in their natural environment (Hales et al. 1999, Holbrook et al. 2022). Ocean warming will extend the belt where ciguatera occurs.

The impact of rising temperatures and increased human and infrastructure pressures on coastal land and resources—the coastal squeeze—have had a parallel impact on agriculture. Increasing populations have resulted in shorter agriculture fallow periods, and declining soil fertility has impacted productivity and the ability to grow certain foods. Ocean salt spray makes growing fruits and vegetables difficult, and severe weather events (for example, heavy rain followed by intense sun can destroy staple crops, forcing people to purchase store foods) (Albert et al. 2020). The combination of reduced food security from land and sea affects nutrition and health (Savage et al. 2020a, 2020b). That is exacerbated after hazards.

Hazards

A warmer climate gives rise to more extreme weather conditions. Hazards influence health status more directly. During 2002-03 when Vanuatu experienced five cyclones, the incidence of malaria doubled that of the preceding year (Lal et al. 2009). Experiencing two different cyclones in a single week in 2023 increased physical damage, water pollution and anxiety levels in Vanuatu. During Cyclone Pam in 2015, tree crops were destroyed, the cost of food in the markets increased significantly (remaining high for several years) and reduced the availability of mangoes and breadfruit for more than three years (Savage et al. 2021a). Local foods are most costly after hazard events when market supply is most limited, but most needed, so many households necessarily switch to imported, cheaper and 'easier' foods such as rice. Every hazard is a catalyst to change. Over time such changes, notably the transition to urbanisation and consuming processed foods and away from production, contribute to the Pacific epidemic of NCDs.

Flooding after cyclones has negative effects on health, with the greater incidence of skin and vector-borne diseases. Damage to homes and pollution of water makes recovery more difficult. Flooding may contribute to such water-borne diseases as typhoid and cholera—evident in localised outbreaks in several PICs – as in Pohnpei (FSM) in 2000 (Kirk et al. 2005). Loss of access to safe water supplies accentuates the incidence of diseases such as cholera and diarrhoea, with a positive correlation between temperature, and a negative association between water availability, and diarrhoea incidence. As in Fiji the number of diarrhoea cases increases, alongside higher temperatures, with extremes of either very high or very low rainfall (Singh et al. 2001, McIver et al. 2012, Nelson et al. 2022). Such circumstances are particularly prevalent in the atoll states: Kiribati, Tuvalu, Tokelau and Marshall Islands (Singh et al. 2001) and in urban settlements where alternative water sources are absent, and adequate public hygiene is difficult. El Niño events, and their

contribution to increased hazards, has been linked to outbreaks of malaria, cholera, dengue and other diseases. Hazards also have impacts on the increased mortality of fauna, whether native or domesticated, due to the hazard itself, food shortages, predation by animals or humans, and failure to breed. Greater incidence of hazard events, and temperature increases, worsens health status, and increases the social and economic costs of health care. For example, during Cyclone Pam in 2015, parts of the causeway connecting Betio to other islets in urban South Tarawa (Kiribati) were destroyed so that access to the hospital there was almost impossible and its maternity ward flooded in storm surges, placing the health of mothers and infants in danger.

Droughts have long been present in the Pacific, notably in atoll states such as Kiribati and Tuvalu, with populations migrating to escape droughts in the nineteenth century. They are likely to become more severe in future (Iese et al. 2021). The 2011 drought in Tuvalu brought a significant reduction in the supply of local food since watering food gardens was impossible (McCubbin et al. 2015, Corlew 2012). Twelve years later, the 2023 drought in Kiribati emphasised the health and nutrition implications, since it caused stress, and affected water security for domestic tasks (cooking and bathing), for drinking (since well water was brackish) and for agricultural development (with coconuts failing to ripen, hence copra sales were absent). In Tuvalu and Tokelau, health was affected by people drinking polluted lens water, and being unable to wash themselves and their clothes as frequently as usual; crops (breadfruit and taro) failed, water and desalination plants were shipped in from as far as New Zealand, and rations imposed in both PICs.

Higher temperatures contribute to wildfires in the Pacific. Tropical grasses that fuel most fires accumulate large amounts of biomass when there is ample rainfall, and bushfires (wildfires) have become more common, from Yap (FSM) to New Caledonia. With climate change increasing the intensity of both rainfall events and drought, seasons will be more difficult to predict and fires more difficult to control, with negative impacts on ecosystems and property, and thus indirectly on health.

Wind Waves

Wind waves, similar to those in cyclones, have increasingly been recognised as an occasional (perhaps once in five years) problem in the PICs, associated with distant cyclones in mid-latitudes in the eastern Pacific. In combination with high tides, and regional high sea levels in association with ENSO, they cause considerable damage, more widespread but less severe than cyclones. A single event in 2008, with a 3000 km wave front, flooded islands and coasts in FSM, Marshall Islands, Kiribati, Nauru, PNG and Solomon Islands (Hoeke et al. 2013). Several of these islands, especially Nauru, and islands in PNG and Solomon Islands, are outside of the normal range of tropical storms, which are infrequent close to the equator.

Once again, the impact on livelihoods is particularly severe in atolls, without high ground, such as Takuu (Bougainville, PNG), where the 2008 event destroyed taro and other crops, about 25 homes and other island infrastructure, including the school, other government buildings, churches and many seawalls (Smithers and Hoeke 2014). The same event caused widespread problems in Micronesia, with the atoll of Kapingamarangi (FSM) losing about

90 percent of its taro. A similar event in the outlying atolls of Chuuk (FSM) flooded them to a depth of more than 25 cms: village households on Lukunor atoll lost most of their staple breadfruit and taro through salination, wells were rendered temporarily unusable (and the contaminated lens aquifer was no longer available as a reserve water supply), some houses were damaged and multiple cases of skin, respiratory and gastrointestinal infections followed (Keim 2013).

Ocean flooding extended through the Marshall Islands, parts of PNG and Solomon Islands and most of FSM late in 2021, exacerbated by La Niña (which temporarily raised sea levels by as much as 20cm in the western Pacific), flooding houses and roads for three days (Radio New Zealand, 7 December 2021). A high-pressure system from New Zealand in mid-2022 produced swells of up to 4.5 metres in the Cook Islands, inundating coastal areas and damaging homes and roads. The same event produced destructive swells as large as 9 metres in French Polynesia. Fifteen houses on the west coast of Tahiti were submerged and the owners were evacuated. In neither PIC had similar waves occurred for at least a decade. A state of emergency was declared in American Samoa because of the damage to roads, infrastructure, and coastal villages. Sea level rise will mean that such wind waves, in combination with high tides, are increasingly likely and such episodic events—versions of the effects of cyclones—are more likely to challenge the habitability of small islands than progressively rising sea levels. Flooding poses immediate health problems and increases stress levels amongst those challenged by climate change.

The Human Presence

Climate change impacts cannot easily be disentangled from other factors affecting health. Anthropogenic pressures on coasts have intensified: higher population densities and untreated waste inputs into lagoons are a threat to livelihoods and health. Lagoons and fringing reef systems are degraded. Coastal erosion is exacerbated by beach sand mining and seawall construction. Deforestation, the breakdown of traditional subsistence production, and low incomes, have contributed to poor nutrition and health-related problems to the extent that the nutritional deficiency disease, beriberi, reappeared in 2014 after an absence of fifty years (Nilles et al. 2018). In the humid urban heat islands, higher temperatures have increased the extent of respiratory diseases, and greater sedentarism and diets of imported processed foods have worsened the extent of NCDs, the so-called 'lifestyle diseases', to levels higher than in other parts of the world. NCDs are a prominent health concern in all PICs, where they reach levels higher than in most other parts of the world, and climate change is one of the main structural risk factors, mainly because of the impact of hazards on reduced food and nutrition security (Savage et al. 2021b). Excessive heat is slowly becoming a silent and invisible killer, and newly emerging evidence indicates that diseases linked to microbiome dysfunction—such as cancer, diabetes and obesity—could be partly transmissible, especially in overcrowded contexts (Callaway 2023). There is good evidence from other similar contexts, of both direct and indirect linkages between climate-induced weather events and the increased prevalence of diseases such as malaria, diarrhoea, cholera, skin disease and lung diseases, affecting the relative health, safety and wellbeing of poor, disadvantaged and densely crowded urban communities (Damte et al. 2023) adding to social determinants of health that already disadvantage relatively poor communities.

Mental Health

Extreme weather events increase post-traumatic stress disorders, as hazards threaten or destroy homes and livelihoods (Fritze et al. 2008). Even young children, at least in Samoa, are conscious of and concerned over the greater incidence of disease that follows heavy rain and flooding, and therefore of the need to limit climate change (Latai et al. 2023). Underpinning physical health is a widespread if rather indeterminate 'climate anxiety' or 'ambient stress': the fear of what climate change is doing and will do to lives and livelihoods. Obvious impacts on mental health occur where people confront the uncertain future of their island homes and livelihoods, and are further linked to frustration and disharmony as people must resettle on land that is not traditionally their own. In a cluster of islands off Malaita (Solomon Islands) that have experienced some physical changes, including sea water flooding houses and food gardens at high tides, and where people are concerned about the absence of any land where they might resettle, almost everyone experiences greater concern ('persistent worry') over the future, and people are stressed enough to have modified their behaviour towards family members and the wider community (Albert et al. 2018, Asugeni et al. 2015).

Where people have begun to relocate in the face of coastal erosion, flooding and saltwater intrusion—primarily the outcomes of climate change—, both positive and negative health impacts have followed; in Fiji, where people from the village of Vunidogoloa have moved two kilometres away and uphill from their previous coastal site, water supply and sanitation improved and people had better access to livelihood opportunities, health services and schools. Unanticipated risks to health involved greater consumption of processed foods, cigarettes and alcohol, and disrupted place attachment (to ancestral land, garden land and burial sites) with consequences for mental wellbeing. Domestic violence increased partly because of the new uncertainties and the greater prevalence of nuclear rather than extended families. The planned (and carefully monitored) relocation of the village thus restructured the social determinants of health (McMichael and Powell 2021).

Typically, in the Solomon Islands, comparison of three villages indicated that the one most at risk of being affected by climate change, because of its location on a reef island, was also the one where depression was greatest (Furosawa et al. 2021). In Tuvalu (and elsewhere) the uncertainties of environmental change have resulted for many in worry, disrupted sleep and sadness (Gibson et al. 2019, 2020), as the 'old order' of land tenure, indigenous knowledge and cultural heritage, centred on the place of ancestors, is disrupted. As one Tuvaluan woman said: 'I'm sad because of losing our house, because the house is like your parent, where you live all your life. It protects you' (quoted in Gibson et al. 2020: 2). This has led some to fear that links between climate change and suicidal behaviour elsewhere may be replicated in the Pacific (Mathieu et al. 2021). These climate change related stressors are not always distinguishable from mental health issues associated with substance abuse and increased domestic violence (Palinkas et al. 2022) both of which have become more significant in uncertain places and times.

Health Services

Where climate change increases the burden of disease, greater pressure on human resources follows. The experience of COVID-19 drew attention to widespread and serious concerns over the paucity of adequate skills, vaccines and technology, and the need for more effective health governance in many PICs (Campbell and Connell 2021, Phillips et al. 2022). In Solomon Islands, in a prelude to COVID-19, health services could not cope with a dengue outbreak in 2016-2017. Quality of care at the key National Referral Hospital for the increased number of patients was affected by the lack of basic equipment, unavailable transport for nurses to attend shifts, and confusion between allowances for nurses, all of which reduced morale and increased burnout – problems that recurred with greater severity when COVID-19 arrived. That was exacerbated by lack of familiarity with dengue and inadequate training to cope with its distinctive requirements. Other health staff experienced their own problems (with their own health and that of their families sometimes being affected) and, as the outbreak continued, nurses became exhausted and absenteeism increased, further challenging the system (Goulolo et al. 2021). Universally, managerial failures reduced the quality of care.

Even before COVID-19, and several recent cyclones, health workforces were inadequate in most PICs to meet the health care needs that followed hazards (Rumsey et al. 2014). Climate change-induced epidemics are likely to pose similar problems, especially in outer islands – where small islands are particularly threatened by climate change, and health services are weak. Indeed, much of the Pacific is characterised by an inverse care law, where places and people most in need of medical care are most distant from it. However, being often located in urban coastal areas, health services are prone to hazards (as was Betio's maternity ward, see above p.6). Niue's only hospital was destroyed by Cyclone Heta in 2004 and its replacement built further inland. More catastrophically, in 2016, Cyclone Winston damaged 88 health clinics and medical facilities in Fiji, causing an estimated F$13.9 million (US$6.3 million) in damage (UNICEF 2021), rendering some inoperable when they were most needed. Indeed, at such times health workers are overextended and often need to look after their own families, a situation particularly true during COVID-19, especially where the epidemic coincided with cyclone hazards. That may become even more challenging as many PIC health services are currently experiencing an unprecedented loss of skilled workers, especially nurses, through attrition and migration overseas (where their skills are often lost).

Conclusion

As global warming intensifies, most of the more serious impacts of climate change on health still lie in the future, and are likely to be the indirect consequence of less adequate and self-reliant livelihoods, through reduced incomes and weakened food and water security, rather than the direct impact of diseases. Nevertheless, malaria, malnutrition and NCDs may engender high morbidity and mortality rates. New diseases are becoming significant as temperatures increase and mosquitoes migrate. Outbreaks of mosquito-borne disease, notably dengue, that have no treatment, have the potential to overwhelm the health systems of small island nations (Russell et al. 2022), and to be costly for individuals, households and

the PICs. The most basic need is for the reduction of global emissions and deceleration of the rate of climate change, which would deliver health benefits. Regionally and nationally, developing more climate resilient health systems with the capability to deliver services and anticipate and respond to problems is vital. However, many existing health problems have been recognised for much of this century and have yet to benefit from changed foci, policies and practices. That does not bode well for solutions to address new health impacts from climate change.

At a national scale, urban planning, rare in the Pacific, could reduce pollution and deliver green spaces (that are aesthetic, provide space for recreation and exercise, and absorb rainwater, so reducing flash floods). Places that promote active transport, where more people walk or cycle, and planting of trees (that provide shade and minimise heat islands) can also reduce air pollution, with benefits for respiratory and cardiovascular health, and could slow the NCD epidemic. Revaluing local knowledge would contribute to food security and biodiversity but that is too often overlooked. Climate change emphasises the need for integrated and interdisciplinary multi-sectoral solutions (McFarlane et al. 2019, Connell and Campbell 2021, Rendell and Sheel 2022). Just as health problems may be the indirect outcomes of climate change, so the emerging blue economy and approaches to improved health demand a focus on improved livelihoods, fisheries and agriculture and coastal zone management (Savage et al. 2020b).

Since health issues have similarities across the region, most hazards affect several countries simultaneously, and countries have relatively few skilled health managers, having shared policies and interventions for PICS makes sense. These might occur both through WHO (and other Asia-Pacific regional organisations including UNICEF since solutions require action across multiple sectors), Pacific regional organisations (such as the Secretariat for the Pacific Community) and through NGO partnerships such as the Pacific Rim Climate Health Equity (PARICHE) network (Palinkas et al. 2002).

The COVID-19 pandemic and anthropogenic climate change are parallel global crises, both emphasising underlying societal inequities and problems of poverty, substandard housing, water and infrastructure (Pelling et al. 2021): the underlying social determinants of health. As the Pacific Islands Forum has stated: 'health security is at the heart of national and regional security, because when health is affected every[thing] else is affected' (2022: 210). While COVID-19 pointed to the need for better access to improved health services, it came at a time of more static economies, increased stress and climate anxiety, so that the PICs remain vulnerable to pandemics. All this has occurred at the same time as an intensified coastal squeeze puts greater pressure on livelihoods and environments, reducing resilience and increasing vulnerability. Impacts are greater in the archipelagic atoll states, where health systems are relatively weak and the inverse care law prevails. The most vulnerable populations—children in most places, female residents of densely populated urban settlements, the aged and people with disabilities, and those living on atolls—will experience the greatest impacts, alongside those facing greater food, nutrition and water insecurity after cyclones: the single most potent hazard in the region.

Climate change poses global challenges as rising temperatures, recurring natural disasters, and resulting increases in the extent and prevalence of acute and long-term climate-related

diseases threaten the health and safety of PIC populations. Moreover, extreme events and hazards are likely to increase in future (Swain et al. 2020). Consequently, climate change presents a real threat not only to human health, but to livelihoods and stability and thus, alongside the threat of a new pandemic, emphasises the challenge of developing adequate public health interventions to mitigate the steadily growing threat to local and regional security. Underpinning good health is water and food security, effective health promotion (crucial to reduce the incidence of NCDs), and reasonable access to affordable health care especially for those in urban settlements. That requires capacity building, with more effective adequately paid skilled health workers (who may then be less prone to migrate) and support from regional and international agencies, for what are unprecedented interdisciplinary development changes and challenges.

The healthcare sector, one of the largest sources of greenhouse gas emissions globally, both exacerbates and suffers from this challenge. Health systems must not only build climate resilience to withstand disasters but also to implement sustainability initiatives that will reduce the sector's carbon footprint, alongside established goals to improve the health of the population, improve the responsiveness of the health system to that population and provide social and financial risk protection. Health systems may achieve these goals through interrelated 'building blocks' each of which must become climate resilient (World Health Organization 2015b). Central to these for the PICs is strong leadership, essential for good governance, trust in institutions, evidence-based policy making and strategic planning, to ensure implementation, and to address the complex and long-term nature of climate change risks and its effects on the health system. This requires cross-sectoral planning particularly in sectors that have a strong influence on health, such as water and sanitation, nutrition, energy and urban planning. The viability of service delivery, especially during and after hazards, is essential, hence health systems need to ensure workforce capability and flexibility, including aged care and primary care. Necessarily this requires continued and stable funding, nationally and through donor assistance, to build expertise and capacity into the longer-term health system response. For small states these represent urgent requirements and pressures, while still 'building back better' after COVID-19, and facing difficult challenges in warmer days ahead.

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