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Protecting Human Health from Climate Change

Human Health Vulnerability to Climate Change in Fiji

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Contents

This information paper is an output from the Piloting Climate Change Adaptation to Protect Human Health (PCCAPHH) project in Fiji, 2013".

1. Introduction

Climate change negatively impacts the basic determinants of human health- clean air, safe and sufficient water, food and shelter. Direct impacts of climate change on health include injury, disease and death from extreme heat and cold, cyclones, floods and droughts. Indirect impacts include increases in vector-borne, water-borne, cardiovascular, respiratory and renal diseases and psychosocial impacts from increase in the range and number of disease spreading vectors, compromised food and water sources, livelihood losses and population displacement. Fiji is especially vulnerable to adverse health impacts of climate change, due to its small geographical size, exposure to extreme climate events and a small economy that depends largely on natural resources.

This information paper demonstrates the impacts of climate variables, like temperature and rainfall and extreme events on human health in Fiji and lists some adaptation measures that need to be implemented. There are clear links between climate and communicable diseases (CDs or infectious diseases) like dengue and typhoid fevers, leptospirosis and diarrhoeal illnesses and between extreme climate events like floods and droughts and malnutrition. Anecdotal evidence from health practitioners also suggests a link with non-communicable diseases (NCDs), particularly those related to nutritional deficiencies. While further research is required to identify the true burden of climate-attributable health risks in Fiji, enough evidence exists globally to underscore adaptation and mitigation in the health and related sectors (in particular, energy, transport, water, housing and agriculture).

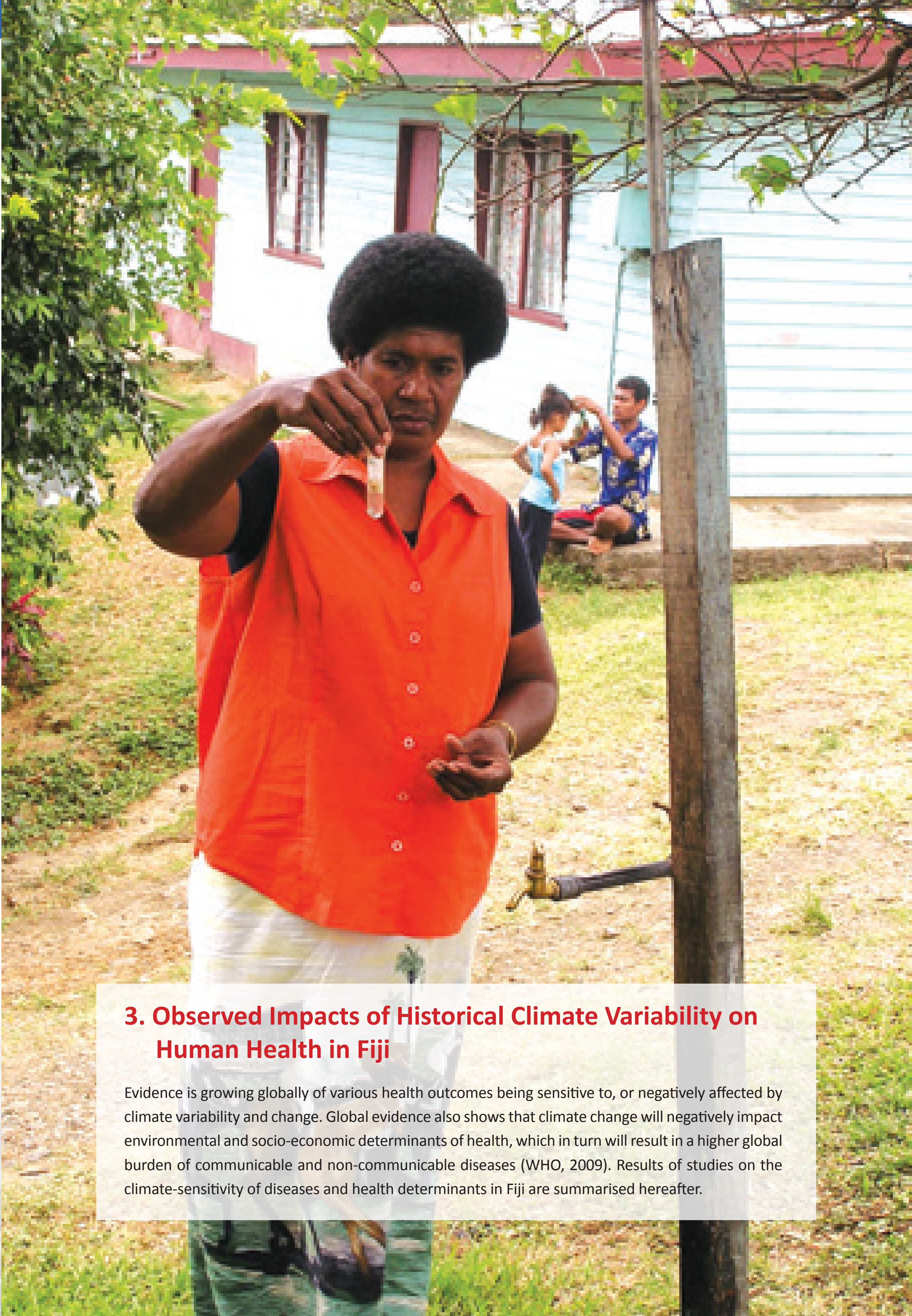
2. Background- Key Health Indicators for Fiji

In recent years, Fiji's population (868,000 in 2011) has increased at 1% per year. In the past 50 years, the rural population has decreased from 70% to just under 50% of the total, which has put significant strain on services in urban areas, in particular water and sanitation. Gross national income per capita has been stable at around $4500 over the past 5 years. Overall, 23% of the population live on less that $2 per day (US$ PPP); 43% of rural population and 18% of the urban population live below the poverty line. Income is unequally distributed: the top 20% of earners receive 50% of the income, while the poorest 20% receive only 6% (World Bank, 2012). Government health expenditure is approximately 3.7% of gross domestic product annually (Snowdon, 2012).

In 2010, the top 2 causes of mortality were diseases of the circulatory system and endocrine, nutritional and metabolic diseases. Child mortality fell from 23.2/1000 live births in 2009 to 17.7/1000 live births in 2010. Maternal mortality fell from 27.5/100,000 live births in 2009 to 22.6/100,000 live births in 2010 (Ministry of Health, 2011). Poverty, the inability of many to buy sufficient food and unhealthy diets have caused significant amounts of micronutrient (especially iodine and iron) malnutrition (Snowdon, 2012). A survey of youth in the Suva-Nausori corridor revealed that 26% of females and 17% of males were overweight, more than 30% of Indo-Fijian students were under-weight and less than 30% of students engaged in any physical activity (Tuiketei et al., 2010).

Approximately 82% of all deaths in Fiji are attributed to NCDs (WHO, 2011). Of these, 42% are from cardiovascular diseases alone. As per the Fiji NCD STEPS Survey report 2002, the prevalence of diabetes was 16.2% and prevalence of hypertension was 19.1% (Ministry of Health, 2005). These rates are anticipated to have increased in the 2011 NCD STEPS Survey. Interestingly, though unfortunately, mortality due to diabetes for 2011 was recorded to be 53.5% more than in 2010. The prevalence of cancers in 2011 was noted to be 10.9% with the female to male ratio being 3:1 (MoH, 2012a).

With regards to CDs, the incidence of tuberculosis, a disease of poverty, declined between 2009 and 2010 (Ministry of Health, 2011). In the last 50 years, about six distinct outbreaks of dengue were experienced in the country. On average, about 20-100 cases of leptospirosis are reported in the country annually. While data shows that the incidence (number of cases per 100,000 of population) of typhoid fever may be increasing, improved diagnosis and reporting since 2005 may help explain the rise in numbers. Together, dengue fever, leptospirosis and typhoid fever are considered the country's "Three Plagues" and with diarrhoea, are major public health concerns (PCCAPHH, 2012). In 2010, 19,234 cases of diarrhoea were recorded nationally (Ministry of Health, 2011). Between 1995 and 2010, the incidence of diarrhoea was nearly always more than 500 cases per month (PCCAPHH, 2012). While diarrhoea is known globally to be sensitive to climate conditions, poor water and sanitation concerns also play a major role. Nearly all of the population is said to have access to improved water sources, but 70% of the rural population do not have improved sanitation (World Bank, 2012).



3. Observed Impacts of Historical Climate Variability on Human Health in Fiji

Evidence is growing globally of various health outcomes being sensitive to, or negatively affected by climate variability and change. Global evidence also shows that climate change will negatively impact environmental and socio-economic determinants of health, which in turn will result in a higher global burden of communicable and non-communicable diseases (WHO, 2009). Results of studies on the climate-sensitivity of diseases and health determinants in Fiji are summarised hereafter.

3.1 Communicable Diseases

A. Dengue fever

In a study conducted in 1999, positive correlations were indentified for dengue and La Nina conditions in the Pacific (Hales et al., 1999). Of the eight dengue outbreaks that occurred in Fiji over the last 50 years, 7 occurred during periods of La Nina (wet conditions), while the 1998 outbreak occurred during the an El Nino (dry conditions) period (PCCAPHH, 2012). It is thought this was due to people storing water in un-covered containers close to their homes and that these containers were ideal breeding sites for the Aedes mosquito (FMS, 2003a). Following the floods in January and March, 2012, the incidence of dengue fever was very high in the Western Division. Vector indices and dengue case numbers both peaked a month following the respective floods. The highest number of laboratory confirmed cases were noted in the Lautoka and Nadi sub-divisions (Ministry of Health, 2012b). Dengue outcomes in Lautoka following the floods were consistent with the results for Lautoka in Table 1 below.

The joint Ministry of Health-WHO-UNDP Piloting Climate Change Adaptation to Protect Human Health utilised historical monthly climate and communicable disease data from 1995-2009 and identified the following associations between dengue and climate conditions.

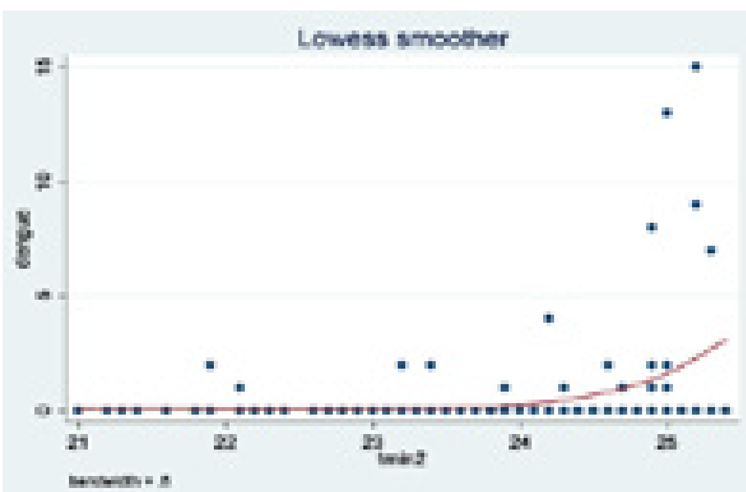
Table 1: Summary of Poisson Regression Between Monthly Dengue Fever Cases and Monthly Climate Variables in Four Medical Sub-Divisions in Fiji

Medical Sub-division	Climate variable/model[a]	Strength of Association (pseudo r^2 value)[b]	Notes:
Ba	Rainfall (mm) - lag[c] 1, 2, 3 Maxtemp (°C)[d]- lag 0, 1, 2, 3 Mintemp (°C)[e]- lag 2 Relative Humidity (%)- lag 1 Best Model: Rainfall, Maxtemp, Humidity at lag 1	0.3, 0.27, 0.32 0.29, 0.38, 0.32, 0.29 0.25 0.34 0.39	[a] Seasonally adjusted, using a dummy variable for months. [b] All results are significant to the 5% level (p-values ≤ 0.05) [c] Lags refer to the relationship between disease numbers in a particular month and climate conditions of the same month (lag 0), or 1, 2, 3 months prior (lags 1, 2, 3) respectively. [d] Maximum temperature [e] Minimum temperature
Bua	Rainfall- lag 0, 1, 2 Maxtemp- lag 0, 2, 3 Mintemp- lag 0, 1, 2, 3 Humidity- lag 0 Best model: Rainfall, Maxtemp, Mintemp at lag 0	0.4, 0.3, 0.37 0.37, 0.33, 0.31 0.35, 0.30, 0.32, 0.31 0.33 0.52	
Lautoka	Rainfall- lag 1 Maxtemp- lag 1 Mintemp- lag 1 Best model- Rainfall, Maxtemp, Mintemp at lag 1	0.42 0.53 0.27 0.54	
Suva	Rainfall- lag 2 Maxtemp- lag 3 Mintemp- lag 0, 2 Humidity- lag 2 Best model- All four climate variables at lag 2	0.47 0.50 0.57, 0.52 0.47 0.6	
(Source: PCCAPHH, 2012)			

Where higher r² values are seen (Lautoka, Suva and Bua) climate conditions can be said to explain dengue fever outcomes to a greater extent. In other sub-divisions, the associations were weaker but still statistically significant.

Relationships between dengue and climate appeared to be non linear. For example, in the Bua sub-division, night-time temperatures above a threshold of approximately 25°C appear conducive to dengue transmission, with a time lag of 2 months (Figure 1).

Fig. 1: Monthly dengue cases vs. Average Monthly Minimum Temperature Two Months Prior in Bua



Further work was done to determine the association between dengue fever and extreme climate events like droughts, cyclones and floods. The likelihood of a dengue outbreak in Ba, one month after floods caused by tropical depressions was 10 times more than months when no tropical depression occurred. Furthermore, the likelihood of a dengue outbreak in Ba during drought months was 5 times more than months without droughts.

B. Diarrhoeal Illnesses

Singh et al. (2001) undertook a study of diarrhoea in infants in Fiji and showed positive associations with very low and very high rainfall and increasing temperature (lagged by one month). Singh et al. noted a 3% increase in diarrhoea cases for every 1°C increase in temperature, controlling for seasons. Higher temperatures create conditions that allow pathogens to proliferate while water supply and safety, as well as sanitation and hygiene are compromised during periods of droughts and floods. Following the March 2012 floods in the Western Division, water supply and safety were compromised in both urban and rural flood-affected areas, resulting in a high incidence of diarrhoea. In many areas, water trucks supplied water to affected families; 2779 WASH kits (containing water purification tablets, water containers and soap), 40 large tanks and bladders, 7,000 water containers, and 9600 sachets of Oral Rehydration Salts (ORS) were also distributed (UNOCHA Pacific, 2012).

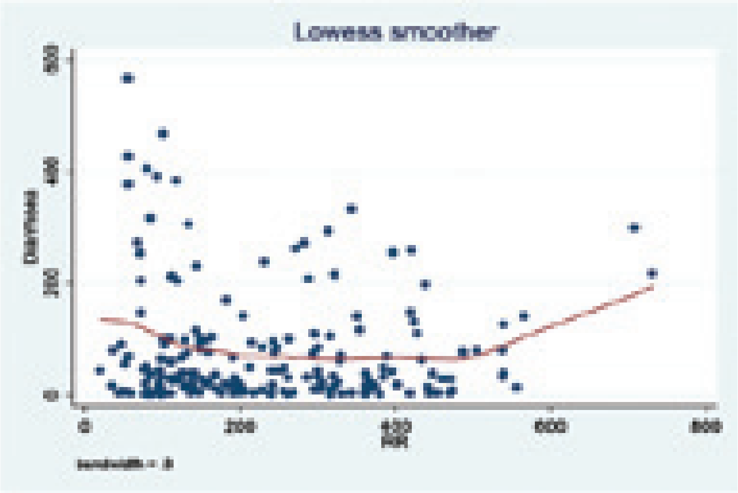
Analysis by the PCCAPHH project (2012) produced the following associations between climate and diarrhoea.

Table 2: Associations Between Monthly Diarrhoeal Illnesses and Monthly Climate Variables in Three Medical Sub-Divisions in Fiji, 1995-2009

Medical Sub-division	Climate variable/model[a]	Strength of Association (pseudo r^2 value)[b]	Notes:
Ba	Rainfall- lag 1 Maxtemp- lag 3 Mintemp-lag 3 Humidity- lag 1 Best model: All for climate variables above	0.1 0.06 0.07 0.14 0.17	[a] Seasonally adjusted, using a dummy variable for months. [b] All results are significant to the 5% level (p-values ≤ 0.05) [c] Lags refer to the relationship between disease numbers in a particular month and climate conditions of the same month (lag 0), or 1, 2, 3 months prior (lags 1, 2, 3) respectively. [d] Maximum temperature [e] Minimum temperature
Bua	Rainfall- lag 0 Maxtemp- lag 0, 1, 2 Mintemp- lag 0-3 Humidity- lag 2 Best model: Rainfall, Maxtemp, Mintemp at lag 0	0.12 All ~0.10 All ~0.10 0.12 0.13	
Suva	Rainfall- lag 1, 3 Maxtemp- lag 0, 3 Mintemp- lag 3 Best model: Three climate variables above at lag 3	~0.4 ~0.4 ~0.4 0.41	

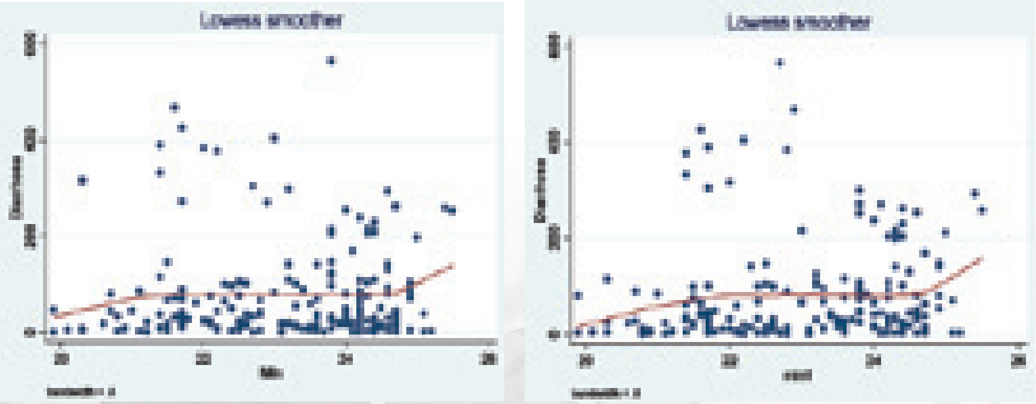
It is clear from the above table that other than in the Suva sub-division, the linear associations between monthly diarrhoea and monthly climate conditions are quite weak. When the same data was analysed using the Lowess smoothing for the Suva sub-division however, the following U-shaped curve was noted, similar to findings by Singh et al. (2001) (Fig. 2). This shows that in the Suva sub-division, diarrhoea cases are higher during periods of very low and very high rainfall, but more pronounced during drier periods (PCCAPHH, 2012).

Fig. 2: Monthly Diarrhoea Cases vs. Average Monthly Rainfall in the same Month in Suva



Interesting associations were also noted with minimum temperature in Suva for the same month and a one-month lag (Fig. 3 below). Both graphs suggest that 25ºC is the threshold minimum (night-time) temperature, beyond which diarrhoea cases increase in the Suva sub-divisions (PCCAPHH, 2012). It is important to consider minimum temperatures as colder temperatures will inhibit the proliferation of certain pathogens.

Fig. 3. Association between Monthly Diarrhoea Cases and Minimum Temperature at Lags 0 (left) and 1 (right) in Suva



Analysis also revealed strong positive associations with extreme events like floods and cyclones in the Ba medical sub-division. The likelihood of a diarrhoea outbreak in Ba one month after flooding caused by tropical depressions is 9 times more than months in which tropical depressions do not occur. In comparison, the likelihood of a diarrhoea outbreak one month after all floods is 3.5 times higher than all months without flooding (PCCAPHH, 2012).

Analysis above shows the need to design adaptation measures to both abrupt and on-going changes in the climate, noting all the while the communicable diseases to tend to rise following natural climate disasters.

C. Typhoid Fever

Typhoid fever is endemic in Fiji. Outbreaks have been noted following floods and 2 months after cyclones (Jenkins, 2010; Ram et al., 1983) and mass food distribution events. Outbreaks in Koroboya and Naitasiri (Tavua medical sub-division) and Nanoko (Nadroga-Navosa sub-division) in 2012 demonstrated that poverty, poor sanitation and hygiene and the movement of healthy carriers are also significant risk factors. The Western Division experienced typhoid outbreaks following the January and March 2012 floods, with the highest number of cases reported in the Ba sub-division, followed by the Nadi and Lautoka sub-divisions. Particularly following floods and cyclones, the close proximity of people in evacuation centres and compromised sanitary and hygiene facilities in evacuation centres also contributes to transmission of typhoid. The Ministry of Health launched a public campaign following the floods and distributed more than 8000 information, education and communication materials on preventing typhoid fever and on maintaining good health during natural disasters (Ministry of Health, 2012b).

Analysis by the PCCAPHH project (2012) produced the following associations between climate and typhoid fever.

Table 3: Summary of Poisson Regression Between Monthly Typhoid Fever Cases and Monthly Climate Variables in Two Medical Sub-Divisions in Fiji, 1995-2009

Medical Sub-division	Climate variable/model[a]	Strength of Association (pseudo r^2 value)[b]	Notes:
Ba	Rainfall- lag 1, 2, 3 Maxtemp- lag 0, 3 Mintemp- lag 1, 2, 3 Humidity- lag 0, 1, 2, 3 Best model- Rainfall and Mintemp at lag 2	0.47, 0.63, 0.49 0.47, 0.49 0.46, 0.52, 0.46 0.48, 0.46, 0.47, 0.5 0.66	[a] Seasonally adjusted, using a dummy variable for months. [b] All results are significant to the 5% level (p-values ≤ 0.05) [c] Lags refer to the relationship between disease numbers in a particular month and climate conditions of the same month (lag 0), or 1, 2, 3 months prior (lags 1, 2, 3) respectively. [d] Maximum temperature [e] Minimum temperature
Bua	Rainfall- lag 0 Mintemp- lag 0, 3 Humidity- lag 3 Best model- Rainfall and Mintemp at lag 0	0.35 0.36, 0.36 0.35 0.36	

Typhoid outbreaks in the Ba sub-division are explained to a significant extent by rainfall and minimum temperature of the area. Results for the Bua sub-division illustrate that other socio-economic determinants can explain typhoid outbreaks in the area.

D. Leptospirosis

Over the last 15 years, between 20-100 cases of leptospirosis have been reported in Fiji annually. While leptospirosis is endemic in Fiji, outbreaks also occur. Globally, leptospirosis is known to be sensitive to higher temperatures and higher rainfall patterns in tropical areas. In Fiji, young male farmers are at higher risk as their occupations expose them to infected animals or soil and water contaminated by faeces of infected animals. It is thought that especially following floods and cyclones, people and leptospirosis vectors (domestic animals, rats) come into closer proximity, increasing the risk of transmission (PCCAPHH, 2012).

For example, leptospirosis outbreaks were noted following floods in January and March 2012 in the Western Division. In some cases, outbreaks occurred in evacuation centres where people were in close proximity. Furthermore, rodents in Ba town are thought to have caused outbreaks in town areas following the January and March floods in 2012 (Ministry of Health, 2012c). The highest numbers of cases following the floods were reported from the Lautoka sub-division, followed by the Ba, Nadi and Nadroga-Navosa sub-divisions. The highest number of deaths due to leptospirosis was also from the Lautoka Divisional Hospital. Health promotion messages to prevent leptospirosis were aired on Fiji TV and FBC, while approximately 6200 information, education and communication materials on the same subject were distributed to the public (Ministry of Health, 2012b).

Analysis by the PCCAPHH project produced the following associations between climate and leptospirosis.

Table 4: Summary of Poisson Regression Between Monthly Leptospirosis Cases and Monthly Climate Variables in Two Medical Sub-Divisions in Fiji, 1995-2009

Medical Sub-division	Climate variable/model[a]	Strength of Association (pseudo r^2 value)[b]	Notes:
Ba	Rainfall- lag 2 Maxtemp- lag 1, 2 Humidity- lag 1, 2 Best model: Rainfall lag 2 and Mintemp lag 1	0.3 0.32, 0.3 0.3, 0.3 0.35	[a] Seasonally adjusted, using a dummy variable for months. [b] All results are significant to the 5% level (p-values ≤ 0.05) [c] Lags refer to the relationship between disease numbers in a particular month and climate conditions of the same month (lag 0), or 1, 2, 3 months prior (lags 1, 2, 3) respectively. [d] Maximum temperature [e] Minimum temperature
Bua	Rainfall- lag 0, 2, 3 Maxtemp- lag 0, 3 Mintemp- lag 0, 1, 2, 3 Humidity- lag 0, 1 Best model: Rainfall, Maxtemp, Mintemp at lag 3	0.42, 0.4, 0.48 0.38, 0.45 0.4 (all) 0.45, 0.40 0.59	

The strongest correlation between average monthly climate conditions and monthly leptospirosis was noted for the Bua sub-division, with a model that combined rainfall, maximum temperate and minimum temperature at a lag of 3 months.

E. Sexually Transmitted Infections

While no quantitative studies have been undertaken to determine the association between sexually transmitted infections (STIs) and the climate in Fiji, some observations following the January and March floods in the Western Division are noted below. Medical practitioners noted an increase in unsafe sexual activities, particularly among teenagers and youths, and especially so in evacuation centres. As a result, group activities like yaqona consumption were banned in most evacuation centres to encourage parents to supervise their children. Furthermore, cases of rape and incest were also noted, especially on unaccompanied women in evacuation centres. To prevent further cases, police officers were posted at evacuation centres and where necessary, women were housed in separate rooms in evacuations centres and provided police protection (Ministry of Health, 2012c).

3.2 Non-Communicable Diseases

While non-communicable diseases (NCDs) are known globally to be sensitive to diet, no quantitative studies have been undertaken to demonstrate associations between NCDs and the climate in Fiji. Thus, this is an area of research, especially as some examples of associations are starting to become more visible and as NCDs are significant health problems. Some of the pathways in which climate change can affect NCDs are explored below.

A. Heat-related illnesses

While Fiji does not experience heat-waves like those experienced in many temperate countries, hotter days are expected to create conditions where people engage in less physical activity (working on farms or exercising outside). This can lead to a rise in obesity, which is a risk factor for many NCDs like diabetes, cardio-vascular illnesses, musculo-skeletal disorders (like gout and osteoarthritis) and some cancers like endometrial, breast, rectal and colon cancer (National Food and Nutrition Centre and Ministry of Health, 2009). Increased heat levels could also cause increased restlessness in high blood pressure patients, creating conditions for increase in related illnesses.

B. Malnutrition-related illnesses

Perhaps the most important potential pathway linking climate change and NCDs is via food and nutrition. Currently, endocrine, nutritional and metabolic diseases are the second most common cause of mortality in Fiji (Ministry of Health, 2011). Extreme temperatures, as well as natural disasters like droughts, cyclones and floods cause significant damage to agricultural output. More than 12,000 farmers lost their crops and the agriculture sector overall incurred a loss of more than FJD16m after the March 2012 floods (UNOCHA Pacific, 2012). This resulted in fresh fruit and vegetable shortages throughout the Western Division. The Ministry of Health distributed nutritional supplements that included Vitamin A and micronutrients to avoid malnutrition in flood-affected families (UNOCHA Pacific, 2012). Where farms are unable to recover from natural disasters, long-term shortages of fresh, local fruits and vegetables are experienced. As a result, people consume canned and preserved food, which are often high in salt and sugar. Excessive amounts of salt and sugar increase the risk of illnesses like high-blood pressure, strokes and cardio-vascular diseases, diabetes and obesity. Anecdotal evidence suggests an increase in diabetic foot-sepsis among people in the Eastern Division two years after Cyclone Tomas' destruction of farms in the area.

Climate change is also causing sea surface temperatures and sea levels to rise and altering the mixing of ocean layers which reduce nutrient availability and fish supply. Rising sea surface temperatures, and increasing variability in the form of the El Nino Southern Oscillation will negatively impact coral reefs, leading to further reduction in fisheries (FAO, 2008). Seafood is an important source of protein in Fiji and the lack of fresh fish will further push consumers to buy canned fish, which are normally high in salt.

In the long-term, damages suffered by the agriculture and fisheries sectors may create significant food security issues, including very large increases in NCDs and very high dependence on imported foods.

C. Death and injury from extreme events

Drowning from swimming in flooded rivers, or trying to cross flooded crossings is a major cause of death during floods and cyclones. A summary of deaths from recent major cyclones and floods is presented below.

Table 5: Deaths During Major Recent Cyclones and Floods

Extreme Event	No. of deaths	Source
Hurricane Ami (January 2003)	17	FMS, 2003b.
Floods due to Tropical Depression (January 2009)	11	McGree at al., 2010.
Tropical Cyclone Mick (December 2009)	9	ABC News, 2009.
Floods due to Tropical Depression (March 2012)	4	UNOCHA Pacific, 2012.

Deaths cause grief and sorrow in affected families and if families lose their bread-winners, then their losses are greater. Related impact on the mental health of family and friends is varied yet quite notable. The possibility of depression and stress increases during such times.

D. Psychological impacts

A largely neglected health impact of climate change and extreme climate events, the UNOCHA Pacific coordinated Humanitarian Response Team recognised this as an important area following the March 2012 floods (UNOCHA Pacific, 2012). Psychological stress and depression can arise from loss of livelihoods (e.g. drought damage to crops), death of or immobilising injury to family members, loss of homes to floods and/or cyclones, the inability to recover from disasters, conflict over limited resources like water/productive land and the relocation or displacement of populations to less vulnerable, and in some cases more vulnerable areas. It can affect adults, children and youth and can take the form of "social isolation, mental disorders, reduced socio-economic status and associated health problems" (WHO, 2009: 12).

3.3 Access to Health Services

Hurricane Ami (January 2003) caused FJD857,000 of damage to health infrastructure (FMS, 2003b). The March 2012 floods caused FJD607,000 damage to health infrastructure (UNOCHA, 2012). Buildings, equipment, drugs and records get damaged from water and wind and replacement costs are very high. Electricity and water cuts also severely limit the operability of health facilities. In addition, access to health facilities and affected communities is also cut-off by flooded roads and bridges. Transporting emergency cases to hospitals becomes difficult during such times (Ministry of Health, 2012c) and health practitioners are forced to attend to emergency cases at great personal risk. The Ministry of Health recently reviewed its Health Emergency and Disaster Management Action Plan (HEADMAP), which includes Standard Operating Procedures (SOPs) to address some of the issues raised here. Current practice during disasters is for health teams, comprising medical officers, nurses, environment health officers and dieticians, to undertake shift clinics and outreach in evacuation centres and communities to maintain population access to health services.

4. Projected Impacts of Climate Change on Human Health in Fiji

Fiji's climate is projected to continue to warm over the coming century. Days and nights are expected to become warmer, with 35°C days and over 16°C-21°C nights becoming regular occurrences by 2100. Generally, the country is projected to get drier and sea levels are expected to rise (Government of Fiji, 2012). These changes will have profound impacts on availability of water, agriculture, food and living conditions. In other words, climate change will continue to compromise the basic determinants of human health.

Studies undertaken using the PACCLIM model in 2005 (Government of the Fiji Islands, 2005) projected increases in the incidence of dengue fever, diarrhoea and nutrition related illnesses in Fiji. Using 1990 as the baseline, 43% of Viti Levu was found to be at low risk of a dengue outbreak. By 2100, even under the B2 (sustainable development) scenario, only 21% of Viti Levu (interior of the island) was projected to be at low risk of a dengue outbreak, with the remainder of the population estimated to be at moderate to high risk of an outbreak. When the worst case scenario (A2) was considered, 45% of Viti Levu's population was projected to be at high to extreme risk of an outbreak by 2100. The study also concluded that as a result of warming, the frequency of epidemics may increase, epidemics may cease to be seasonal (occur at any time of the year) and even become endemic, and the morbidity and mortality from epidemics could rise significantly.

The same study concluded that as Fiji trends towards a warmer climate with more frequent droughts, water and sanitation would be compromised leading to increased diarrhoeal outbreaks. Nutrition related illnesses were also projected to increase as extreme events occur more frequently and increase in intensity. Finally, the study projected serious health impacts if climate change disrupted Fiji's social, economic and ecological systems (Government of the Fiji Islands, 2005).

Failure to adapt locally and mitigate globally would result in the above impacts being felt in Fiji. Some adaptation measures to protect human health from climate change are listed below.

5. Adaptation Measures

Some measures to protect human health against the impacts of climate change are outlined below. It is important to note that improved human health outcomes will depend on adaptation and progress in ALL development sectors. At a recent global Webinar on climate change and health, Prof. Kris Ebi, an international expert on the subject made the following comments about health adaptation. Firstly, it will have to be iterative i.e. measures will have to modified as climate changes in the future. Secondly, there is enough evidence to start implementing adaptation activities, including many win-win activities (AlertNet, 2012).

A. Health sector adaptation measures

Many adaptation options for the health sector involve strengthening existing disease surveillance, monitoring and control measures while others require systematically incorporating climate information in health planning and interventions. Some health adaptation measures for Fiji include:

- Continuous health vulnerability assessment for communicable and non-communicable diseases and for safety and accessibility of health facilities/healthcare.
- Improve access to primary health care.
- Integrated vector management by building or strengthening partnerships with relevant stakeholders.
- Facilitate rapid and accurate disease notification.
- Identify and protect the health of the most vulnerable members of society (elderly, disabled, women, children, poor).
- Vaccinate humans against diseases like typhoid fever and livestock and pets against diseases like leptospirosis.
- On-going education and training on climate change, disaster risk reduction, community health adaptation, etc.
- Incorporate climate change into existing health policies and plans.

B. Natural disaster-specific measures

- Strengthen disaster risk reduction, recovery and response programmes. This includes Standard Operating Procedures and health staff and facilities being adequately resourced (funding, personal protective equipment, food rations, electricity, water, communications).
- Improve coordination among inter-sectoral partners (DISMAC and UN Humanitarian Assistance group).
- Develop or strengthen early warning systems.
- Climate-proof health infrastructure. This includes relocating health facilities if they are in vulnerable areas, ensuring facilities have back-up or renewable electricity, water (e.g. installation of water tanks), sufficient drugs and supplies during natural disasters and undertaking regular repair and maintenance.

C. Adaptation in other sectors- water, agriculture, rural development, housing, environment, community empowerment and livelihoods, energy, etc.

The WHO argues that human health should be the bottom line of all adaptation activities and programmes (WHO, 2009). A healthy population is a resilient population and for these reasons, ALL development sectors in Fiji must aim to improve human health outcomes through their adaptation activities. Some priority sectoral and inter-sectoral adaptation measures are highlighted below.

- Provide clean water, improved sanitation and household disinfection especially in areas where disease incidence is higher.
- Improve social indicators like education, women's empowerment, improved housing and equitable access to development opportunities.
- Improve economic indicators like employment rate, alternative livelihoods and access to markets.
- Enhance community resilience against climate change and disasters.
- Encourage agricultural diversification and sustainable agriculture. Discourage farming in marginal areas.
- The natural environment is a source of food, shelter, medicine, clean water and air. It also acts as a buffer against extreme climate events like floods and cyclones. Moreover, an unpolluted environment is safe for human habitation whereas an altered environment may create conditions for disease microbes and vectors to spread. (Corvalan et al., 2005). For these reasons, ecosystems must be protected from unsustainable use.
- Local mitigation measures like increased use of public transportation, walking/cycling instead of using fossil-fuel powered transport, use of efficient wood-stoves that emit less smoke create co-benefits for health while reducing greenhouse gas emissions.

(Ministry of Health, 2012c; WHO, 2009)

6. Conclusion

To summarise, health facilities and healthcare services, communicable and non-communicable diseases and all the basic determinants of health are sensitive to climate conditions. Impacts are projected to become worse as climate change continues. This highlights the need for urgent adaptation in the health and other development sectors and urgent, up-scaled mitigation of greenhouse gases globally. To conclude, human health should be the bottom-line of all adaptation activities and increased funds are required to secure the necessary human and other resources for adaptation to take place at the required rate.

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