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ORIGINAL ARTICLE

TEMPERATURE VARIABILITY, DENGUE DISEASE AND KIRIBATI: A BRIEF OVERVIEW

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Abstract:

In Pacific Island countries, including Kiribati, beside natural disasters, climate change would exacerbate the human vulnerability to numerous infectious diseases like dengue. The climate of the Republic of Kiribati is hot and humid. The country is vulnerable to climate change due to its unique characteristics. The Island nation consists of33 atoll islands, 32 of which are low lying. The atolls are divided into three different groups; Gilbert, Line and Phoenix. Like other sectors, for example, agriculture and water resources, human health, especially dengue will be affected by climate change. The country has already faced several dengue outbreaks; the latest outbreak took place in 2008. The temperature projections by CSIRO show that by 2050, the temperature increase under a high emission scenario is to be in the range of 1.0-2.2 for the Gilbert Islands, 1.1-2.1 for the Phoenix Islands, and 1.0-2.0 for the Line Islands. The result of this paper shows that temperature variability influences the transmissions of dengue disease through creating favorable condition of vector population growth. Vectors become infectious in warm temperatures. The trend of high temperature will exacerbate the dengue transmission in the future of Kiribati. The study of World Bank also projected the high dengue epidemic potential; according to their projection by2025 the epidemic potential will be 0.22, which is identified as a high epidemic potential. On the other hand, the adaptation strategy did not suggest any specific adaptation strategy for dengue disease transmission reduction. The strategy mainly emphasizes the mainstreaming of climate change adaptation with other development plans. However, the country has two adaptation programs; Kiribati Adaptation Program (KAP) and National Adaptation Programme of Action (NAPA). Though, both programs identified dengue as a vulnerable sector, no program suggested any specific adaptation strategy for dengue. In KAP, among 50 top coping strategies, raising awareness got the top priority. The recommended adaptation strategies of this paper are divided into three categories; technical options, educational and advisory options, and cultural and behavioral options. The report also recommended the establishment of a monitoring and evaluation team to monitor and evaluate adaptation strategies.

KEYWORDS:

Adaptation, climate change, dengue, disease, KAP, Kiribati, NAPA, Pacific Islands, temperature, Vector borne, variability.

INTRODUCTION

Global warming, resulting from greenhouse gas emissions, will cause sea level rise and other

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extreme climatic events to the Pacific Island nations, and indirectly impacthuman health as well (Woodward et al. 2000).Climate change would intensify the vulnerability of Pacific Island countries due to their unique characteristics (Henna et al. 2011). The dispersed atolls in the Pacific Ocean are quite susceptible to the anticipated impacts of climate change (Rodgers et al. 2009). Besides natural disasters, climate change would exacerbate the human vulnerability to numerous infectious diseases, including dengue(Henna et al. 2011). Extended hot and wet weather events would accelerate rapid growth of vector populations, which in turn would spread diseases like malaria and dengue diseases (Rodgers et al. 2009). The vector borne infections will mainly affecturban population due to rising temperatures and shifting rainfall patterns (Woodward, Hales & Weinstein 1998).

Aedesaegypti and Aedesalbopictus, two species of mosquito, are the main vectors of dengue disease. If their introduction were inadvertent, the likelihood is that a warmer climate would be ideal to allow their survival establishment in certain areas (Woodward, Hales & Wet 2001). Climatic conditions, particularly warm and hot temperatures contribute to vector endurance and reproduction, and can significantlyalterdisease transmissions (Patz et al. 2003).

The republic of Kiribati hasthe great susceptibility to dengue disease. The country has already faced four-dengue epidemics in 1970 and 1980; two in 1970 and two in 1980. The country's densely populated area; South Tarawa is the most susceptible to dengue outbreaks. This area has a consistent ideal temperature (310C) for dengue epidemics (World Bank 2000). The dry season is responsible for increasing the range of vectors of the country Peoples' movement the other factor that influences the dengue disease increases in this season as well (Ministry of Environment and Social Development 1999).

In Kiribati, by 2050, the projected rate of efficiency of the disease transmission will increase by 22-33 percent. The possibility of dengue disease outbreaks in South Tarawa is highly likely (Ministry of Environment and Social Development 1999).

RESEARCH QUESTION

The research questions of this paper were- how does temperature variability relate to dengue disease in Kiribati and what arethe adaptation strategies to decrease instances of this disease?

AIMS AND OBJECTIVES

This paper aimed to present climate change adaptation activities to decrease impacts of dengue diseases in Kiribati.

Objectives of the paper are as follows-

To present temperature modelling data of Kiribati;
To present current instances within the population of dengue disease;
To describe how this disease within the population are affected by temperature; and
To propose adaptation strategies to decrease the instances of dengue disease

METHODOLOGY

To conduct this desktop research various resources have been used to achieve the aims and objectives of the paper. The following table shows the methodology used to prepare this paper.

Objective	Methodology
Objective 1	Data from Commonwealth Scientific and Industrial Research Organisation (CSIRO) have been presented for discussion.
Objective 2	Resources from World Health Organisation (WHO) and World Bank have been used
Objective 3	Peer reviewed journal and literature, for example, Patz et al., and Woodward et al., have been reviewed to support the discussion of the relationship between temperature and vector borne diseases
Objective 4	National Adaptation Program of Actions (NAPA) of Kiribati (2007), Vanuatu (2007), Tuvalu, and Solomon Islands (2008)have been used.

Table 01: Methodology

RESULTS

Relationship between temperature variability and vector borne (dengue) disease

Temperature along with precipitation is an influential factor for vector borne diseases (Patz et al. 2003). Warmer temperatures and higher humidity present the best conditions for the growth of seasonal diseases like dengue (Hales, Edwards &Kovats 2003). Relationships between temperature variability and vector borne diseases are shown in the following figure.

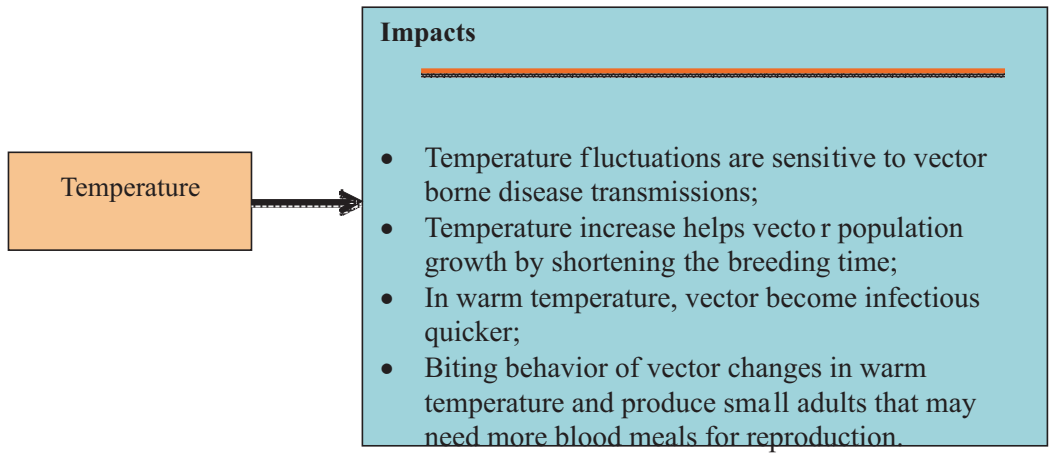

Figure 02: The relationship between temperature and vector borne diseases (Source: Adapted from Hales, Edwards &Kovats 2003 and Patz et al. 2003)

Although, temperature is a factor in disease transmission in the Pacific, including Kiribati, a subsequent study of Hales et al. shows ENSO also has significant influences on the prevalence of dengue. They investigated the possible link between ENSO on the one hand and monthly reports of dengue cases on the other in fourteen island nations in the Pacific (Hales, Edwards &Kovats 2003). Their research revealed a positive correlation between Southern Oscillation Index (SOI) and dengue in ten countries(Hales, Edwards &Kovats 2003).

Adaptation strategies to decrease dengue impacts in Kiribati

Kiribati's climate change adaptation (CCA) strategy aims for mental, physical and financial preparation to deal with the future climatic trends and events through a nationally coordinated, participation-based, adaptation programme implemented by official and private agencies and to meet the costs of the national adaptation programme external financial assistance should be obtained (Kiribati Government 2005). The strategy emphasized the integration of CCA into national planning and institutional capacity to mainstream the CCA. However, the strategy did not suggest any specific adaptation strategy on dengue disease.

Kiribati has two adaptation programs under external financial and technical assistance; National Programme of Action (NAPA) and Kiribati Adaptation Program (KAP). The NAPA and KAP have been implemented concurrently, and both projects share the uniform coordinating bodies.

DISCUSSION

Kiribati's future temperature

Temperature projections by CSIRO indicate that the annual average temperature will increase in all emissions' scenarios (low, medium and high)(Pacific Climate Science Program Partners 2011). CSIRO used the output from global climate model simulations of the future climate in preparing the future temperature projections for Kiribati.The following table shows the projections of temperature changes in Kiribati for three-time periods in three emission scenarios (Pacific Climate Science Program Partners 2011). The base line for this projection was the average temperatures of the period between 1980-1999.

		2030 (^{0}c)	2050 (^{0}c)	2090 (^{0}c)
Gilbert Islands	Low emissions scenario (B1)	0.2-1.2	0.7-1.9	1.0-2.4
	Medium emissions scenario (A1B)	0.2-1.4	0.9-2.3	1.7-3.5
	High emissions scenario (A2)	0.3-1.3	1.0-2.2	2.2-3.8
Phoenix Islands	Low emissions scenario (B1)	0.2-1.2	0.7-1.9	1.0-2.4
	Medium emissions scenario (A1B)	0.4-1.4	1.0-2.2	1.7-3.5
	High emissions scenario (A2)	0.4-1.2	1.1-2.1	2.3-3.7
Line Islands	Low emissions scenario (B1)	0.2-1.2	0.6-1.8	1.0-2.4
	Medium emissions scenario (A1B)	0.3-1.3	1.0-2.2	1.6-3.4
	High emissions scenario (A2)	0.4-1.2	1.0-2.0	2.3-3.5

Table 02: Kiribati's temperature projection (Source: Pacific Climate Science Program Partners 2011)

The above table shows the temperature of Kiribati will increase in all emission scenarios. By 2050, the projected increase temperature under a high emission (A2) scenario is to be in the range of 1.0-2.2 for the Gilbert Islands, 1.1-2.1 for the Phoenix Islands, and 1.0-2.0 for the Line Islands.

Current instances and future projections of dengue disease

While the Kiribati Government did not submit any official report to the World Health Organisation (WHO), in 2008, the country faced a dengue epidemic (WHO 2009). A total of 837-dengue cases were reported over 12 months, which caused concern in Kiribati as well as other countries in the region (WHO 2009). It was the last dengue outbreak in this pacific country. A projection of dengue fever epidemic potential is presented in the following table from the World Bank study on dengue in Kiribati.

Impact	Baseline (1990)	2025	2050	2100
Projected epidemic potential	0.18	0.20	0.22-0.24	0.25-0.36
Percentage change from 1990	N/A	11	22-33	39-100

Table 03: The projection of dengue fever epidemic potential (Source: World Bank 2000)

The measure of the efficiency of disease transmission is the epidemic potential index. A value of 0.2 or above is considered a high epidemic potential (World Bank 2000). It shows the dengue epidemic potential trend of Kiribati is high from 2025, and this trend will be higher in further future.

The influence of temperature on the current instances of Kiribati

As mentioned earlier, the climate of Kiribati is hot and humid, and the year round temperature variation is comparatively constant across the country ((Pacific Climate Change Science Program partners 2011). These hot and humid temperatures created a favorable situation for the dengue outbreak by changing the biting behavior, and expanded vector population by shortening the breeding time. Generally the temperature of Kiribati fluctuates from 230 C to 340C, while the average temperature is 280 C (Aregheore 2009). All these factors contributed to the occurrence of the dengue outbreak in Kiribati.

Beside temperature, Hales et al. noted with some grave concerns that local weather patterns at times might cause an increase of transmission in bigger and more populated islands where the disease is more widespread and endemic (Hales, Edwards &Kovats 2003). In such a scenario, the infected people are

then likely to carry the disease to smaller neighboring islands. This brings home the point that the effect of climate on vector-borne diseases is not only limited to the area adversely affected by altered and changed climate, suggesting in the process that climate forecasts may require, as of need, to take cognisance of a given areas or the region's social customs, population movements and, most importantly its environmental factors (Hales, Edwards &Kovats 2003).

Adaptation Programs of Kiribati

The two adaptation programs of Kiribati, NAPA and KAP, are discussed in the following box briefly.

NAPA	KAP
NAPA is financed by the Global Environmental Facility (GEF) th rough the assistance of UNDP; it focuses mainly on the urgent and immediate necessities It does not have any specific adaptation action or strategy to decrease dengue disease transmission, though , it identified climate change will exacerbate the den gue disease in Kiribati. It only described the project profile of water resources, agriculture, fisheries and coral reefs, and coastal management or adaptation strategies will help to improve the environment and resources, which indirectly decrease the occurrences of diseases.	KAP isfinanced by the World Bank; it focusesmainly on long term planning for adaptation. Health is identified as one of the vulnerable sectors along with some other sectors in coping strategies of KAP . In KAP, among 50 top coping strategies, raising awarenessgot the top priority. However, the aims of KAP are to decrease the vulnerability to climate change, climate variabi lity and sea level rise by raisingawareness about climate change, assessing and protecting available water resources and managing inunda tion. The KAP already expanded into phase 3, but the program does not have any specific adaptation action

Box 1: NAPA & KAP in brief (Source: Adapted from Terorko 2007 & (Office of the President of the Republic of Kiribati n. d.)

Comparison of Kiribati's adaptation strategies with neighboring countries' adaptation strategies

The initial national communication under the United Nations Framework Convention on Climate Change (UNFCCC) of Kiribati, the Solomon Islands and Vanuatu has identified human health as a vulnerable sector of climate change, but Kiribati and Vanuatu adaptation strategies did not suggest any specific adaptation action, and the adaptation strategy of Solomon Islands have not found. However, in every mentioning country and Tuvalu, The National Adaptation Program of Action (NAPA) is the basis of adaptation activities. A brief comparison among these countries' NAPA, and Kiribati's NAPA and KAP are presented in the annex 1.

CONCLUSION

The future temperature projection of Kiribati presented in the discussion as objective 1 of this paper shows that future temperatures of the country will be warmer and hot days will increase in the future. This trend of high temperature will exacerbate dengue transmissions. A result of this paper showed temperature has significant influences on vector population growth and transmission. These factors influenced to recent instances of dengue in Kiribati. The study of the World Bank also shows a high trend of future epidemic potential of dengue.

The result of this paper also shows that in the Pacific, including Kiribati, except temperature, some other factors, for example,ENSO, population movement, density and regional customs, also have a

significant influence on dengue transmission.

However,the desktop research of this paper found out Kiribati does not have any specific adaptation strategy to reduce the rates of dengue transmissions. The adaptation strategies emphasize the mainstreaming of climate change issues in all other development plans. Raising awareness got the top priority among 50 coping strategies; it could be an effective adaptation strategy for health sectors, especially for dengue transmission reduction.

Recommendations, and the way forward

Specific adaptation strategies (see table 05) are required to decrease the transmissions of dengue in Kiribati. The strategies should focus on all levelsof participation; national, local and community. The recommendations of adaptation strategies of this paper are discussed in the table below. These recommendations also combine the other countries' adaptation strategies suitable for Kiribati.

Technical options	Educational & Advisory	Cultural & Behavioral
• Country wide vector control program; • Mandatory vaccination program for the entire population; • Establishment of a sophisticated early warning system for dengue disease, for example, the early announcement system of possible upcoming dengue outbreaks on the mass media: radio, television, and newspaper. • Dengue specialization in the health facilities and up the priority of dengue specialized doctors and instrument for dengue testing. • Development of a training manual for community training on dengue issues; for example, a guide book on basic dengue knowledge and its relation with temperature.	• Community training on basic dengueknowledge and issues to raise awareness among the communities and cyclic basis (every 1 year) awareness raising campaign at the community level • Inclusion of dengue disease and its relation with temperature into the primary and secondary school curriculum books.	• Control the movement of people during peak season of dengue.

Table 05: Adaptation Strategies (Source: Adapted from Stalker 2006)

Apart from adaptation strategies this project also recommends-

Establishment of a monitoring and evaluation team to monitor and evaluate the adaptation activities and to observe the dengue situation;
Effective institutional arrangement and mainstreaming dengue issue with other sectors working on climate change through integrate way.

REFERENCES

1.Aregheore, EM 2009, Country pasture/forage resource profile: Kiribati, Food and Agriculture Organisation, Rome, viewed 27 June 2013,
<http://www.fao.org/ag/agp/AGPC/doc/Counprof/southpacific/kiribati.htm>.
2.Department of Environment 2007, National Adaptation Programme of Action (NAPA), Ministry of

Natural Resources, Environment, Agriculture and Lands, Tuvalu, viewed 24 June 2013, <http://www.unfccc.int/resource/docs/napa/tuv01.pdf?>.
3.Hales, S, Edwards, SJ &Kovats, RS 2003, Impacts of climate on health of climate extremes, global change, World Health Organisation, viewed 26 June, <www.who.int/globalchange/publications/climatechangechap5.pdf>.
4.Henna et al. 2011, overview of climate change impacts on human health in the Pacific region, draft report, Department of Climate Change and Energy Efficiency, Commonwealth of Australia, viewed 04 June 2013, <http://www.climatechange.gov.au/sites/climatechange/files/files/ANU_Impacts_on_Human_Health_-_FINAL.pdf>.
5.Kiribati Government 2005, Climate change adaptation (CCA) strategy, Republic of Kiribati, viewed 25 June 2013, <http://www.environment.gov.ki/CC/KirCCA%20Strategy%202005.pdf>.
6.Ministry of Environment, Conservation and Meteorology 2008, National Adaptation Programmes of Action (NAPA), The Republic of Solomon Islands, viewed 25 June 2013, <http://www.unfccc.int/resource/docs/napa/slb01.pdf?>.
7.Ministry of Environment and Social Development 1999, Initial Communication under the United Nations Framework Convention on Climate Change, Kiribati Government, viewed 01 June 2013, <http://www.sprep.org/att/IRC/eCOPIES/Countries/Kiribati/28.pdf>.
8.National Advisory Committee on Climate Change (NACCC) n. d. National programme for action, The Republic of Vanuatu, viewed 26 June 2013, <http://www.unfccc.int/resource/docs/napa/vut01.pdf?>.
9.Office of the President n. d. Kiribati adaptation program, the Republic of Kiribati, viewed 26June 2013, <http://www.climate.gov.ki/category/action/adaptation/kiribati-adaptation-program/>.
10.Pacific Climate Change Science Program partners 2011, Current and future climate of Kiribati, Kiribati Meteorology Service, Australian Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organisation (CSIRO), viewed 05 June 2013, <http://www.cawcr.gov.au/projects/PCCSP/pdf/11_PCCSP_Kiribati_8pp.pdf>
11.Patz et al. 2003, Climate change and infectious diseases, global change, World Health Organisation, viewed 04 June 2013, <http://cdrwww.who.int/globalchange/publications/climatechangechap6.pdf>.
12.Rodgers et al. 2009, Climate change and health: a pacific perspective, Regional case study on Commonwealth Health Ministers update 2009, viewed 01 June 2013, <http://www.thecommonwealth.org/files/190386/FileName/SPCregionalpaper_2009.pdf>
13.Stalker, P 2006, Technologies for Adaptation to climate change, United Nations Framework Convention on Climate Change, Bann, viewed 27 June 2013, <http://unfccc.int/resource/docs/publications/tech_for_adaptation_06.pdf>.
14.Terorko et al 2007, National Adaptation Program of Action (NAPA), Kiribati Climate Change Study Team, Government of Kiribati, viewed 04 June 2013, <http://unfccc.int/resource/docs/napa/kir01.pdf>.
15.Woodward, A, Hales, S & Weinstein, P 1999, Climate change and human health in the Asia Pacific region: who will be the most vulnerable, Climate Research, vol. 11, pp. 31-38, viewed 30 May 2013, <http://climatehealthconnect.org/sites/climatehealthconnect.huang.radicaldesigns.org/files/resources/AWoodward_0.pdf>.
16.Woodward et al. 2000, Protecting human health in a changing world: the role of social and economic development, Bulletin of the World Health Organization, vol. 78(9), pp. 1148-55, viewed 02 June 2013, <http://www.who.int/bulletin/archives/78(9)1148.pdf>.
17. Woodward, A, Hales, S. & Wet, ND 2001, Climate change: potential effects on human health in New Zealand, New Zealand Climate Change Programme and Ministry for the Environment, viewed 03 June 2013, <http://www.mfe.govt.nz/publications/climate/effect-health-sep01/effect-health-sep01.pdf>.
18.World Bank 2000, Cities, seas, and storm: managing change in Pacific Island economics, vol. iv, adapting to climate change, World Bank-Papua New Guinea and Pacific Islands Country Unit, viewed, <siteresources.worldbank.org/INTPACIFICISLANDS/.../4-VolumeIV+Full>.
19.World Health Organisation (WHO) 2009, Dengue guidelines for diagnosis, treatment, prevention and control, WHO, the Special Programme for Research and Training in tropical Diseases (TDR), Geneva, viewed 27 June 2013, <http://whqlibdoc.who.int/publications/2009/9789241547871_eng.pdf>.

Annex 01

Country	Strategy	Similarity	Difference	Suitability for Kiribati or not
Solomon Islands	• Institutional arrangement with different ministries also working on climate change areas. The Ministry of Health and Medical Services (MHMS) will integrate the climate change into the National Health Policy and Strategic Plan	• Kiribati's CCA strategies also suggest the mainstreaming of climate change adaptation	• Health issues not specifically mentioned in the strategy	Yes
	• Community training on health issues to raise awareness among the communities.	• One of the top priorities of Kiribati's climate change program is raising awareness.	• Method of raising awareness has not been mentioned.	Yes
Tuvalu	• Suggested as one of the priority projects called 'Strengthening of community health through control of vector borne/climate sensitive diseases and promotion access to quality potable water'.	• Described the project profile of water resources, agriculture, fisheries and coral reefs, and coastal management will help to improve the environment and resources, which will indirectly decrease the occurrences of the diseases	• No specific health or vector borne disease adaptation strategies.	Yes
Vanuatu	• Emphasizes mainstreaming the health issue with other development activities and encouragesinstitutional arrangement.	• Mainstreaming and inclusion of adaptation activities in the other development plans are the strategies of Kiribati as well.		Already exist

Table 04: The comparison of selected countries adaptation strategies (Source: Adapted from Department of Environment Tuvalu 2007, Ministry of Environment, Conservation & Meteorology SolomonIsland 2008, and NACC Vanuatu n. d)