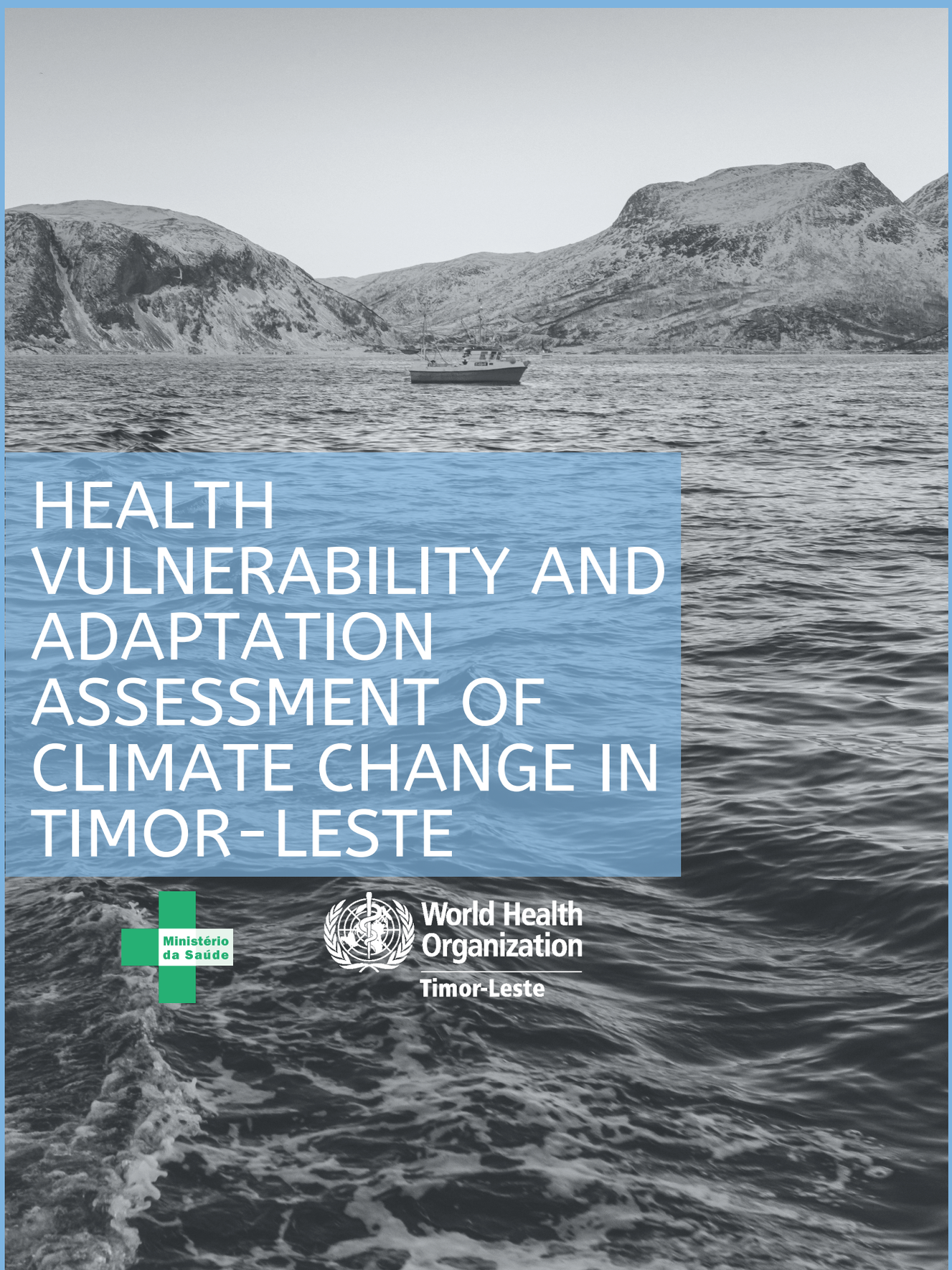

HEALTH VULNERABILITY AND ADAPTATION ASSESSMENT OF CLIMATE CHANGE IN TIMOR-LESTE

Ministério da Saúde

World Health Organization
Timor-Leste

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Executive Summary

Climate change and climatic variability are exacerbating climate-sensitive health outcomes and have the potential to affect the ability of health system. Human health is considered as one of the sectors being highly vulnerable to climate change. There is strong global evidence of impacts of climate variability on human health outcomes and poor regions of the world are most vulnerable to negative effects of climate change. Hence, it has become a global as well as Timor-Leste's concern to address the issue of health effect of climate change. Therefore, the aim of this report is to conduct vulnerability and adaptation assessment of the health impacts of climate variability and change in Timor-Leste. This report is structured according to the WHO/PAHO guidelines on "Protecting health from climate change-vulnerability and adaptation assessment"

The impact of climate change on the health outcomes of the population in Timor-Leste is complex and manifold. Direct impacts of climate change on human health include exposure to thermal extremes and damage to public health infrastructure, increased frequency of physiological disorder and injuries, due to the increase in frequency and/or intensity of extreme weather events. Indirect impacts include disturbances to ecological systems that result in changes to the geographical range and incidence of vector- borne diseases, infectious diseases, malnutrition and hunger that in turn disturb child growth and development. Sea level rises may also force population displacement and cause damage to infrastructure which will lead to increased susceptibility to infectious diseases and psychological disorders. Many infectious diseases such as malaria, dengue fever, diarrhoea and other water and food borne diseases are found to be susceptible to climate change. Increasing temperatures may create more favourable conditions for vectors' development. Precipitation is another important factor that influences insect growth rates, especially mosquitoes and black flies because many of these species breed in the residual water that remains after flooding during the wet season. However, heavy rainfall may wash vector larvae away or kill them directly.

Extreme climate events such as storms and floods directly cause deaths and injuries,

and can also have indirect effects on communicable diseases and livelihoods. Risk maps for extreme events have been developed “Disaster Risk and Hazard Map Analysis for Timor-Leste: An overview of existing risk maps” as a part of project entitled “Disaster Risk Management Institutional and Operational Systems Development in Timor-Leste”, co-funded by UNDP and the Disaster Preparedness Programme of the European Commission’s Humanitarian Aid department (DIPECHO). This study concludes that Timor-Leste faces high levels of exposure to disaster hazards and that there are many vulnerable elements exposed to these hazards. Natural disasters affected 951 per million people on average each year in Timor-Leste. Dili experiences on average eight tropical cyclones per decade, but their effect is weak. El Niño and La Niña have resulted in serious damage and disasters affecting different socioeconomic sectors of the country. Observations have indicated that El Niño events will become more frequent

Weekly (or monthly) data are used for descriptive analysis with graphical presentations and statistical modeling to observe the weekly (or monthly) and annual trends of the meteorological and health effect variables and associate between them through graphical analysis and statistical modeling. Variables other than meteorological variables used are trend effect (annual) variable and seasonal dummies (Wet season: December- April versus dry season: May-November). Results of statistical modeling are obtained separately for the four districts and national estimates based upon the four districts in case of ARI, pneumonia and scabies modeling. In case of diarrhea and dengue modeling all the 10 districts of TimoreLeste have been used to obtain national estimates. Statistical modelling is carried out mainly to associate weather related variables and seasonal effects through negative binomial model (NB) and log-linear model. NB is the generalized linear model (GLM) with log link function suitable for over-dispersed count data. The model is used basically to account the over-dispersed nature of weekly reported ARI, pneumonia and dengue cases. NB model has been used to model separately for the four districts weekly data and dengue national weekly data whereas log-linear model was found suitable for aggregated data of the districts which is representative of the national scenario including the modeling of acute diarrhea and blood diarrhea. For monthly data log-linear model is found suitable and used to

associate between scabies cases and meteorological parameters.

Effects of temperature

Effect of temperature on pneumonia incidence even though found slightly positive with 0.63% rise per 1 0C increase in average temperature is not statistically significant at 5% level. In contrast to effect of average and maximum temperature effects, decrease in minimum temperature is found with increase in pneumonia incidence in TimoreLeste with negative association. District-wise separate effects of temperature are also not consistent on pneumonia incidence.

Decrease in temperature (average, maximum and minimum) is found to increase ARI occurrence with 3.66% (95% CI: 1.16-6.1%) decrease per 10C increase in average temperature and statistically significant at 5% level. The effects are relatively much consistent compared to effects on pneumonia.

Overall increase in temperature (average and minimum) is found to be associated with increase in scabies incidence with p value < 0.4 though statistically insignificant at 5% level with 1.9% rise in the scabies cases per 10C increase in average temperature. However, the association is found to be negative in case of maximum temperature which is an indication of variability in the nature of association and also inconsistent associations and may need further research in this area.

Effects of temperature on acute diarrhea is found to be highly insignificant with high p values. In case of blood diarrhea, average and minimum temperature is found positively associated with 1.07% rise in blood diarrhea per 10C rise in average temperature whereas maximum temperature is found highly insignificant.

Rise in temperature (average, maximum and minimum) is found to increase dengue occurrence with relatively high effects size since 10.85% (95% CI: 0.39-22.4%) rise in dengue incidence per 10C increase in average temperature is detected and the directional effects seems to be consistent as well though not in its magnitude.

Effects of rainfall

Effects of rainfall occurrence on pneumonia incidence does not show strong evidence of association though found positively associated overall with 1.26% rise in pneumonia cases per 1mm increase in rainfall but not statistically significant at 5% level.

Effects of rainfall on ARI incidence is found highly statistically insignificant except in Ermera where 1.27% increase in ARI cases is detected per 1 mm rise in rainfall which is statistically insignificant at 5% level.

Scabies incidence is found slightly negatively associated with rainfall with 0.13% decrease in scabies occurrence with 1mm increase in rainfall though statistically insignificant 5% level.

Acute diarrhea and blood diarrhea tends to increase with occurrence of rainfall with 0.47% (95% CI: 0.05-0.89%) and 0.61% (95% CI: 0.04-1.19%) increase in acute and blood diarrhea per 1mm increase in rainfall, respectively and both the effects being statistically significant at 5% level. However, rainfall is found to be associated negatively with dengue occurrence but the effect is statistically insignificant at 5% level.

Effects of relative humidity

Relative humidity is found to effect positively pneumonia incidence with 1.3% (95% CI: 0.24-2.37%) increase in pneumonia incidence per 1% increase in relative humidity which is statistically significant at 5% level.

Relative humidity is found to effect positively ARI incidence with 1.01% (95% CI: 0.24-1.79%) increase in ARI incidence per 1% increase in relative humidity which is statistically significant at 5% level.

Though found positive association between scabies incidence and relative humidity in Aileu and Dilli districts, the overall effect of relative humidity on scabies cases is found to be highly insignificant with p value >0.4.

Acute diarrhea and blood diarrhea are found to be strongly associated with relative humidity with 1.49% (95% CI: 1.06-1.91%) and 1.8% (95% CI: 1.18-2.43%) rise in acute diarrhea and blood diarrhea per 1% increase in relative humidity, respectively and the effects are found to be statistically significant at 5% level. Moreover, the effect of relative humidity on dengue occurrence is found even stronger with much larger effects size with 21.09% (95% CI: 18.10-24.15%) increase in dengue per 1% increase in relative humidity and the effect is statistically significant at 5% level.

Despite the inherent degree of uncertainty of climate predictions and the complexity of the impact on health in Timor-Leste, priority adaptation actions can be identified. These actions should strengthen already existing health programs: such as those aiming to reduce morbidity and mortality from extreme weather events, to secure access to safe water, food and improved sanitation, and to enhance vector-borne diseases surveillance and control. Therefore, successful and cost-effective adaption in the health sector is based on including climate change considerations into all main budgeting and strategic health planning processes. Simultaneously these have to be aligned with the overall National Adaptation Plan (NAP) to climate change.

WHO's 'operational framework for building climate resilient health systems' promotes ten essential components, which together form a comprehensive approach to health adaptation planning. Relating to the six health sector building blocks, these interrelated components can provide a structure for identifying adaptation actions which would mainstream climate change into sector-wide or vertical programs. This present assessment can be used to identify adaptation actions and develop health national adaptation plan (HNAP). As a next step, it will be crucial to include the identified adaptation actions into the national budget planning process, and to mobilize additional funding for those activities that cannot be covered by available financial resources.

Timor-Leste is currently preparing its second communication report to UNFCCC and also strengthening its National Adaption Plan (NAP) process. To this end sectoral Adaptation Plans are required to strengthen this process and increase adaptive capacity of vulnerable sectors. Taking into consideration of future health risks of climate change,

HNAP is developed to ensure that the management of health risk of climate change is integrated into the overall NAP process including assessing risks, identifying, prioritizing and implementation of adaptation options. Therefore, development of comprehensive HNAP is recommended as next step. Since the interaction between environment and health is far more intimate and complex than is commonly understood; the HNAP will broaden the linkages between the two and recognize key environmental health issues and bring right interventions. HNAP will also strengthen intra/intersectional approach in understanding and addressing the key environment and climate change key issues including social issues. Since some of the environmental health issues are not within the control of Ministry of Health, program need to collaborate with other relevant agencies and programs having specific mandates to address key public health issues.

Further, the HNAP will help in persuading non-health sectors to consider the public health implications of their policies through stronger collaboration with relevant agencies. Therefore, this HNAP will be a good start in defining the roles and responsibilities of environmental health program within the ministry of health and with partner ministries in including health in their policy, plans and programs to address common concerns in coordinated manner. Finally, HNAP may also provide better opportunity for fund mobilization for health adaptation process.

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1. Introduction

Global climate change is an emerging risk factor for human health because the health of human populations is sensitive to shifts in weather patterns and other aspects of climate change[1]. The global climate change occurs due to the accumulation of greenhouse gases (GHGs) in the atmosphere arising from the combustion of fossil fuels[2].There is unanimous scientific consensus that GHGs emissions are generated mainly due to anthropogenic activities which has increased warming of Earth's climate since the 1950s. It is mainly due to anthropogenic activities and is likely to have increased by 1.5-4°C in different representative concentration pathways (RCPs) by the end of the 21st century compared to the baseline years 1850 to 1900[3]. The higher increase of surface temperature has been recorded over the last three decades in the northern hemisphere with the highest increase in the Himalayas[4]. In the meantime, sea level rise has been one of the biggest problem of small island developing states[5].

Climate change and variability directly and/or indirectly affects human health. These effects occur directly, due to changes in temperature and precipitation and occurrence of climate induced extreme events. Indirectly, health may be damaged by ecological disruptions brought on by climate change (crop failures, shifting patterns of disease vectors), or social responses to climate change (such as displacement of populations following prolonged drought). Variability in temperatures is a risk factor in its own right, over and above the influence of average temperatures on heat-related deaths. Biological and social adaptations are more difficult in a

[1] Woodward, A., et al., Climate change and health: on the lastest IPCC report The Lancet, 2014. **383**(April 5): p. 1185-1189.
[2] Haines, A., et al., Climate change and human health: impacts, vulnerability and public health. Public health, 2006. **120**(7): p. 585-596.
[3] IPCC, Climate Change 2013. The Physical Science Basis. Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change-Abstract for decision-makers, T.F. Stocker, et al., Editors. 2013: Cambridge, United Kingdom and New York, NY, USA.
[4] Shrestha, U.B., S. Gautam, and K.S. Bawa, Widespread climate change in the Himalayas and associated changes in local ecosystems. PLoS One, 2012. **7**(5): p. e36741.
[5] SCHMIDT, C. W. 2005. Keeping afloat: a strategy for small island nations. Environ Health Perspect, 113**,** A606-9.

highly variable climate than one that is more stable[1]. The World Health Organization (WHO) estimates that the warming and precipitation trends due to climate change over the past 30 years have already claimed many lives[6]. The greatest health effects of climate change occur in the most vulnerable populations residing in least developed countries and are also currently suffering from the heaviest disease burden which are historically least responsible for GHG emissions indicating an "ethical crisis"[7]. The Lancet commission on "Managing the health effects of climate change" concludes that climate change is the biggest global health threat of the 21st century.

The 5th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) states that climate change presents a fundamental threat to the environmental determinants of health, exacerbating health risks from extreme weather events, to vector-borne diseases to malnutrition and that this threat will be exacerbated in countries where inadequate human resources and economic vulnerability limit the national capacities to prepare for or address impacts of climate change hazards on human health[8]. The risks of climate change on health will be higher in countries where there are competing health priorities and the health system is not adequate to address all the risks.

Ministers of Health of the World Health Organization South-East Asia Region (WHO SEAR) endorsed Male' Declaration and Regional Framework of Action for building health systems resilience to climate change during the 70th regional committee meeting in September 2017. The action plan will be implemented by 2022. Similarly, Regional Plan of Action for Small Island Developing States (SIDS) in the African and South East Asian Regions for the period 2019-2023 correspond to the implementation of WHO Special Initiative on Climate Change and Health in SIDS in the African and South-East Asian Regions of the World Health Organization. Two

[6] The World Health Organisation. The World's Health Report 2002. Geneva: WHO, 2002.
[7] Patz, J., et al., Climate Change and Global Health: Quantifying a Growing Ethical Crisis. EcoHealth, 2007. **4**(4): p. 397-405.
[8] Field, C. B., Barros, V. R., Dokken, D. J., Mach, K. J., Mastrandrea, M. D., Bilir, T. E., ... & Girma, B. (2014). IPCC, 2014: Climate change 2014: Impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects. Contribution of working group II to the fifth assessment report of the intergovernmental panel on climate change.

countries of WHO SEAR Maldives and Timor-Leste are included in SIDS initiative by WHO. Two key activities outlined in the both framework and action plans are for all countries to have health vulnerability and adaptation assessment (V&A) carried out and Health National Adaptation Plan (HNAP) developed. For development of an HNAP, the first step is to carry out health V &A. Timor-Leste has not yet carried out health V&A though some aspects is covered in initial national communication report to United Nations Framework Convention on Climate Change (UNFCCC). The country has recently received Global Environmental Facility (GEF) funds to implement a climate resilient health systems project to be implemented in the next four years. This V&A assessment study is aimed to produce useful baseline information for strategically implementing the project including development of HNAP in Timor-Leste.

1.1 Geography and climate

Timor-Leste is located between latitudes 8'15 and 10'30 south, and longitudes 124'50 and 127'30 east. It is a small country with an area of 14,874km^2, which includes the islands of Atauro and Jaco, and the West Timor enclave of Oecusse. It has varying and dramatic topography with mountainous terrain (up to 3000m) as well as riverine and coastal plains. Fifty-seven percent of its land area is forest or woodland, with settlement comprising only 0.2 per cent[9]. However, the natural environment, forests and woodlands are now significantly degraded and altered by a combination of natural and anthropogenic (resulting from or produced by humans) factors [10]. The Timor-Leste is mostly mountainous with limited land suitable for agricultural purposes.

Climate change

Current

[9]Secretariat for Environment, 2014, Timor-Leste's Initial National Communication

[10] Secretariat for Environment, 2010, Timor-Leste's National Adaptation Programme of Actions to Climate Change

Timor-Leste's climate is affected by the West Pacific Monsoon, which is driven by large differences in temperature the land and the ocean[11]. It moves north to mainland Asia during the southern Hemisphere winter and north to Australia in the Southern Hemisphere summer. As a result of its seasonal arrival, it brings a switch from very dry to very wet conditions. The rainfall has high inter-annual variability, significantly influenced by the El Niño Southern Oscillation, hence the country is vulnerable to drought [12]. The northern region has a unimodal rainfall pattern with distinct wet (4-6 months beginning in December) and dry seasons, while the southern region has a bimodal rainfall pattern, meaning a longer wet season of 7-9 months and two rainfall peaks in December and May[13]. Timor-Leste experiences exceedingly heavy rainfall, and with the mountainous landscape and deforestation for cropping and livestock, is prone to erosion and landslides. Annual humidity averages 80 %[14].

Projected

The understanding of historical and projected climate trends in Timor-Leste is hampered by limited weather data and a lack of country-specific modelling [15]. Timor-Leste 's future can be summarized as follows[16]:

- Temperature will increase by 0.4-1.0°C by 2030
- Rise in number of hot days and warm nights
- Decrease in dry season rainfall and increase in wet season rainfall
- Extreme rainfall days likely to occur more often
- Decrease in frequency of tropical cyclones, but likely increase in intensity of cyclones
- Increase in sea-level rise and
- Increase in ocean acidification

[11] Secretariat for Environment, 2014, Timor-Leste's Initial National Communication
[12]Barnett, J., Dessai, S. & Jones, R., 2003, Climate Change in Timor Leste: Science, Impacts, Policy and Planning. Briefing to Government, Civil Society, and Donors, Melbourne: University of Melbourne and CSIRO
[13] Secretariat for Environment, 2014, Timor-Leste's Initial National Communication
[14] Secretariat for Environment, 2014, Timor-Leste's Initial National Communication
[15]Pacific Climate Change Science Program, 2011, Climate Change in the Pacific: Scientific Assessment and New Research, Volume 2: Country Reports, Chapter 3: East Timor, http://www.pacificclimatechangescience.org/publications/reports/report-climate-change-in-the-pacific-scientific-assessment-and-new-research/
[16] Intended Nationally Determined Contributions (INDC) Timor-Leste

1.2 Demographic and socio-economic factors

According to the 2015 Population and Housing Census, the population of Timor-Leste was 1,183,683 and the population density was 79.3 per square kilomteters[17]. According recent Demographic and Health Survey of Timor-Leste [18], 79% of households have access to an improved source of drinking water (92% of urban households and 74% of rural households), 50% of households have access to an improved sanitation facility (75% of urban households and 43% of rural households), 73% of households have electricity (98% of urban households and 66% of rural households), 41% of the household population is below the age of 15, and 26% were adolescents (age 10-19), 6% of children under age 18 are orphans (one or both parents dead), among primary school age children, 86% of girls and boys were attending primary school and among secondary school age children, 57% of boys and 66% of girls were attending secondary school. Adult mortality rates are 164 (female) and 208 (male) per 1000. The total fertility rate is 5.9 [19]. The population is projected to increase to 1.3 million by 2030. Life expectancy at birth is 66.5 for men and 70.1 for women[20]. Average national fertility is 5.7 (down from 7.8 in 2003), and mean annual population growth in the period 1996-2012 was 2.9 %[21]. The total adult literacy rate (2008-2012) is 58 per cent [22].

Timor-Leste has recently transitioned from a Least Developed Country (LDC) to a Medium Developed Country (MDC), ranking 133 out of 188 states in the UNDP's Human Development Index[23]. The country has a Gini Coefficient of 30.4. Timor-Leste receives a net official development assistance that equates to 6% of gross national income (GNI) [24]. Over 80% of the population depends on the agricultural

[17] General Directorate of Statistics, Ministry of Finance, 2016
[18] General Directorate of Statistics (GDS), Ministry of Health and ICF. 2018. Timor-Leste Demographic and Health Survey. Dili: Ministry of Health and Rockville, Maryaland, USA: GDS and ICF
[19] Human Development Report, UNDP, 2015.
[20] Human Development Report, UNDP, 2015.
[21] Government of Timor-Leste, 2011, Timor-Leste Strategic Development Plan 2011-2030
[22] UNICEF, 2013, Statistics, At a Glance: Timor-Leste http://www.unicef.org/infobycountry/Timorleste_statistics.html
[23] Human Development Report, UNDP, 2015.
[24] Human Development Report, UNDP, 2015.

sector as the main source of income or subsistence, although 30-40% of food is imported[25].Timor-Leste's GDP is USD2.3 billion. Over the past decade, oil and gas resources have come to dominate Timor-Leste's economy. In 2010 the source of Timor-Leste's GDP was 79.3% from petroleum and 20.7% non-petroleum. Non-petroleum GDP in 2010 was composed of agriculture (predominantly maize, rice and cassava), forestry and fisheries (21.4 %), industry and services (56.4%), and public administration (21.5%). Timor-Leste's labour force participation rate is low (30.6%), which reflects the continued prominence of subsistence agriculture [26].

1.3 Health status and health system

Health care service is a fundamental right of all Timorese guaranteed by the constitution. The commitment of the government towards the constitutional obligation and the government's vision to achieve health for all in Timor-Leste is reflected in the National Health Sector Strategic Plans[27]. The future direction for the Health sector of Timor-Leste is laid out in the National Health Sector Strategic Plan (NHSSP) 2011–2030 which was developed in line with National Strategic Development Plan (SDP) 2011–2030 and guides Timor-Leste's Health Sector programs and projects[28]. The strategic plan outlines the structure and process for governance, processes for improving health system and health services delivery the government has committed to. Based on the NHSSP, the MoH programmes and institutions are also developing more details strategies and implementation plans towards their respective targets. A Comprehensive Service Packages (BSP) services at different levels have been defined and structural and programmatic adjustments are being done in the ministry of health and its network to enhance its effectiveness delivering the services and meeting its obligations to the citizen. The Ministry of Health designs, directs, manages and coordinates all government health care and pharmaceutical policy and activities throughout the country. Delivering

[25] Ministry for Economy and Development, 2010,Timor-Leste National Adaptation Programme of Action to Climate Change
[26] National Statistics Directorate, 2013, Timor-Leste Labour Force Survey 2013
http://www.statistics.gov.tl/wpcontent/uploads/2015/04/LFS_2013_ENGLISH_VERSION.pdf
[27] Ministry of Health, 2015.Plan of the National Institute of Health 2015-2019. Dili: Ministry of Health
[28] Ministry of Health, 2011, National Health Sector Strategic Plan 2011-2030

health services at the district level is delegated to the districts. Each of the 13 districts in Timor-Leste has a district health management team headed by the District Director of Health Services.

In Timor-Leste, access to health services poses a major concern as 70% of the population lives in rural areas in small, dispersed villages isolated by mountainous terrain and poor road conditions[29]. It is also reported in that strategy that Timor-Leste has one of the highest malnutrition rates in the world with Timorese children suffering the highest levels of stunting and wasting in the WHO SEARO region. Malnutrition among women also remains a serious concern. Micronutrient deficiencies such as iron, vitamin A and iodine constitute a major challenge.

The demographic health survey of 2016[30] showed improvement in some of the key health indicators and most significantly decline in child mortality. Some of the key achievements of health sector that have contributed to the overall decline in child and maternal mortality are:

- 92% of women in urban areas received ANC from a skilled provider, compared with 81% of those in rural areas.
- Elimination of Maternal and Neonatal Tetanus
- The total fertility rate is 4.2 children, a decline from 5.7 in 2009-10.
- Under-five children mortality, infant mortality and neonatal mortality has declined to 41,30 and 19 deaths per 1,000 live births in the most recent 5-year period
- The prevalence of stunting has declined from 58% to 46% since the 2009/10 DHS.
- The prevalence of underweight children have also declined, from 45% to 40%. However, the prevalence of wasted children has increased from 19% to 24%

[29] WHO Country Cooperation Strategy, Timor-Leste (2015-2019)
[30] General Directorate of Statistics (GDS), Ministry of Health and ICF. 2018. Timor-Leste Demographic and Health Survey. Dili: Ministry of Health and Rockville, Maryaland, USA: GDS and ICF

- The proportion of births taking place in a health facility more than doubled since 2009-10, from 22 percent to 49% in 2016
- Reduction in the incidence of common communicable diseases such as Diarrhoea, Malaria, and Acute Respiratory Infections and improvement in care-seeking during illnesses
- Increase in contraceptive use and marked decline in total fertility rate
- Improved access to sanitation, improved access to clean water
- Adaptation and mainstreaming of implementation of evidence based child survival and high impact nutrition interventions nationwide through Basic Package of Services
- Expansion of community health outreach, health volunteers and mother support groups, the good practices that lead to improvement in home and community care for children especially exclusive breast-feeding rate

Timor-Leste has a three-tiered referral system[31]. The three tiers include one national tertiary hospital, five district referral hospitals and numerous community health centres and health posts. At the district level primary health care is provided through a network of Community Health Centres (CHCs), Health Posts (HPs) and SISCa (Servisu Integrado Saude Comunitaria).

The health services provided by primary health care facilities include the Comprehensive Primary Health Package (CPHC) and those under the national programmes including immunization, maternal and child health, malaria, nutrition, tuberculosis and HIV/AIDS. The health posts are the first level of contact at the community. The health posts are the first level of contact at the community which are staffed with a nurse and a midwife and deliver a package of curative, preventive and promotive care. The CHC provides inpatient and outpatient services and the selected CHCs also offer dental and laboratory services. CHC staff includes a physician (the district medical officer) and also organize mobile clinics for remote

[31] Ministry of Health, 2015. Plan of the National Institute of Health 2015-2019. Dili: Ministry of Health

areas where health posts are not established. Servisu Integrado Saúde Communitaria (SISCa) were introduced in 2008 to improve access to basic health services package and preventive measures at the suco (village) level and SISCa has six components: family registration; nutrition assistance and child health promotion; maternal health and family spacing; hygiene, sanitation and malaria prevention; ambulatory primary care; and health promotion activities.

The district hospitals offer emergency, out-patient and in-patient care and have general practitioners and specialists in surgery, paediatrics, gyneco-obstetrics and internal medicine. The district hospitals provide referral services to cases referred from health posts and CHCs. Finally, the national hospital provides specialized services and has referral linkages for tertiary care with facilities in Australia, Indonesia and Singapore for services not available in the country. Ambulance services are available to transport referral cases. A national laboratory operates in the capital Dili. Timor-Leste is an example of a WHO SEARO member country with a tax-based health system in which health services are provided free at the point of use[32]. Timor-Leste operates a predominantly publicly financed and provided health system, as a result, proportionate government contributions to health care spending are large (90% of total health care expenditures)[33].

Table 1: Key economic and health indicators for Timor-Leste

Indicators	Values
GNI per capita (PPP$ international; 2014)	5080
GDP growth rate per annum (%; 2014)	4.2
Population (million; 2014)	1.2

[32] Guinness, L., Paul, R.C., Martins, J.S., Asante, A., Price, J.A., Hayen, A., Jan, S., Soares, A. and Wiseman, V., 2018. Determinants of health care utilisation: the case of Timor-Leste. *International health*, *10*(6), pp.412-420 (accessed from https://academic.oup.com/inthealth/article/10/6/412/5051851)

[33] World Bank . Health equity and financial protection report – Timor-Leste. Washington, DC: World Bank, 2014. http://documents.worldbank.org/curated/en/959881467992506455/pdf/103445-WP-P146116-Timor-Leste-Health-Equity-and-Financial-Protection-Report-FINAL-PUBLIC.pdf.

Indicators	Values
Infant mortality rate per 1000 live births (2014)	45
Maternal mortality rate (2015 modelled estimate per 100 000 live births)	215
Total health care expenditure per capita (PPP$; 2014)	101
Government share of total health care expenditure (%; 2014)	90.4
Government health care expenditure as a share of total government expenditure (%; 2014)	2.4
Private health care expenditure (% of total health care expenditure; 2014)	9.6
External resources for health (% of total health care expenditure; 2014)	31.6

PPP=purchasing power parity.

Source: World Bank data.[32] cited from[34]

1.4 Climate change and health governance

Timor-Leste has incorporated and implemented a number of policies, priorities and strategies on climate change since Independence in 2002: the country ratified the United Nations Framework Convention on Climate Change (UNFCCC) in October 2006, Kyoto Protocol in 2008, Convention to Combat Desertification (UNCCD) in August 2003 and became a party to the Convention on Biological Diversity (UNCBD) in January 2007. In terms of specific national climate change policies, priorities and strategies, Timor-Leste developed and submitted a National Adaptation Programme of Action (NAPA) in 2011, submitted its Initial National Communication (INC) to the UNFCCC in 2014 and intended nationally determined contribution (INDC) in 2016.

[34] Guinness, L., Paul, R.C., Martins, J.S., Asante, A., Price, J.A., Hayen, A., Jan, S., Soares, A. and Wiseman, V., 2018. Determinants of health care utilisation: the case of Timor-Leste. *International health*, *10*(6), pp.412-420 (accessed from https://academic.oup.com/inthealth/article/10/6/412/5051851)

These have detailed the directions for climate change programmes and integration into achieving climate-resilient development goals. In 2015, this included adopting the 2030 Agenda for Sustainable Development and the Sustainable Development Goals (SDGs), including Goal 13 (to take urgent action to combat climate change and its impacts) and including:

- The strengthening of resilience and adaptive capacity to climate related hazards and natural disasters.
- The integration of climate change measures into national policies, strategies and planning.
- Education, awareness raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.
- The promotion of mechanisms for raising capacities for effective climate change related planning and management in LDCs, focusing on women, youth, local and marginalized communities.

Timor-Leste is currently undertaking its Second National Communication to the UNFCCC, developing national climate change policies and is also preparing for developing a National Adaptation Plan (NAP). Climate change is also embedded in the overarching national strategy –the Strategic Development Plan (SDP) 2011 – 2030 for Timor-Leste, which includes ambitious targets for achieving ecological balance in safeguarding the natural resources and economic needs for the country's sustainable development. However, Timor-Leste is still in the process of developing policy, legal and institutional structures for health, the environment, disaster management, and climate change, and lacks strong coordination mechanisms to effectively mainstream climate change-related health concerns into different sectors. It also lacks strong capabilities in public health and disaster-related data collection and analysis, which would enable a better understanding of vulnerability at different scales.

As a member of the Alliance of Small Island States, Timor-Leste shares similar

vulnerabilities to climate change as other alliance members: more frequent and severe extreme weather events, sea-level rise and saline intrusion, issues of food and water security, heat stress, and increased incidence of vector-borne diseases. Through the National Adaptation Plan of Action, Timor- Leste is specifically targeting health sector capacity to anticipate and respond to the health impacts of climate change[35].

2. Methodology

This vulnerability and adaptation assessment was guided by WHO guidelines "Protecting Health from Climate Change – Vulnerability and Adaptation Assessment 2013" (WHO 2013). Not all of the possible steps in the WHO framework have been included in the present report, due to limitations of local expertise, data and time. However, this assessment is broader in scope and investigates a range of health concerns associated with climate change. Following were major methods employed for conducting the V & A assessment

2.1. Literature review

A literature review was performed to identify historical data and current data on climate variability and change in Timor-Leste, as well as key health information relevant to the assessment. In addition, historical and current data, as well as information on ongoing projects and programs, regional partnerships, and policies relevant to climate and health at the country level were collected. Based on the findings in the literature and secondary data analysis, a vulnerability and risk analysis was performed for the main climate sensitive health outcomes which are globally agreed and are included in IPCC and WHO reports as well as scientific publications. The preliminary findings of vulnerability assessment were validated during stakeholder consultation process such as workshops and individual interviews.

2.2. Key informant interviews

Key informant interviews were conducted to collect policy data and information at the country level. Interviewees were either from one of the key departments or units of the

[35] Secretariat for Environment, 2010, Timor-Leste's National Adaptation Programme of Actions to Climate Change

Ministry of Health (MoH), from other relevant Ministries, Departments, UN organizations and health in-charge of municipalities in June 2018. The outcomes of these interviews were included in the vulnerability analysis of this study.

2.3 Field observation

A team consisting of a person from Ministry of Health, WHO Country Office for Timor-Leste and International Consultant visited three municipalities: Manatuto, Liquisa and Dili for stakeholder consultation, interaction and observation of surveillance systems, health service delivery and other ground situations in June 2018.

2.4. Stakeholder workshops

Two stakeholder workshops were organized by WHO Country Office and Ministry of Health to inform and engage national stakeholders:

Inception workshop

A country-driven inception workshop on "Health Vulnerability and Adaption Assessment to Climate Change to Climate Change in Timor-Leste" was held on 5th June 2018 in meeting hall of Ministry of Health, Dili. The workshop was jointly organized by WHO Country Officer for Timor-Leste and Government of Timor-Leste, Ministry of Health. Mr. Jose Moniz, Head of Department for Sanitation Surveillance and Environmental Health, Ministry of Health inaugurated the workshop by highlighting the objective of the workshop and requested all stakeholders to provide valuable input. The workshop was attended by 25 participants representing from Government, UN Agencies and NGOs (See Annex I). Stakeholders provided very valuable suggestions on the data sources, ongoing adaptation activities and consensus was developed on methodology for assessment. This workshop analysis identified climate change related adaptation needs and Timor-Leste's current adaptive capacity.

Validation workshop

In order to provide feedback on the main findings of Health Vulnerability and Adaption Assessment to Climate Change in Timor-Leste, a one day stakeholder consultation was held in meeting hall of WHO Country Office for Timor-Leste on 8 June 2018. The

workshop was jointly organized by WHO Country Officer for Timor-Leste and Government of Timor-Leste, Ministry of Health. The workshop was attended by 18 people from Government, UN agencies and NGOs (See Annex II). The workshop was inaugurated by Dr. Thele S.R Peiris, Acting WHO Representative to Timor-Leste. The participants provided constructive feedback for carrying out health vulnerability and adaptation of national level taking data of municipalities' level. It was suggested to use health data collected through HMIS and Surveillance system and weather data from Department of Meteorology, Timor-Leste. Stakeholders suggested using quantitative data where possible for impact assessment in addition to qualitative data.

2.5 Collection of health data

The weekly and monthly climate sensitive diseases data were obtained from Surveillance & Epidemiological Department, Ministry of Health. Some health data were of district level and municipality level, and some health data such as diarrhea and dengue were only available aggregated data of national level. As per availability of data either weekly or monthly data were analyzed at district, municipality or national level.

2.6 Collection of meteorological data

Daily meteorological data (temperature, rainfall and relative humidity) were collected from Department of Meteorology and Geophysics (DNME), Timor-Leste. These data were converted to weekly or monthly as per availability of health data.

2.7 Modelling association between climatic variables and health data

2.7.1 Coverage

ARI and pneumonia analysis

Four districts of Timor Leste namely Aileu, Baucau, Dili and Ermera are covered with six years of weekly data (312) for each district resulting to a total of 1248 data points for statistical analysis.

Scabies analysis

Four districts of Timor Leste namely Aileu, Baucau, Dili and Ermera are covered with eight years of monthly data (96) for each district resulting to a total of 384 data points for statistical analysis.

Acute Diarrhea, Blood Diarrhea and Dengue analysis

All the 10 districts of Timor Leste namely Aileu, Ainaro, Baucau, Dili, Ermera, Lospalos, Maliana, Maubesi, SUAI and Viqueque are covered with 10 years of weekly data totaling to 520 data for statistical analysis.

2.7.2 Data

ARI and pneumonia analysis

District-wise weekly data of pneumonia and ARI cases and corresponding meteorological parameters including maximum temperature, minimum temperature, rainfall and relative humidity were used for six consecutive years (2011-2016).

Scabies analysis

District-wise monthly data of scabies cases and corresponding meteorological parameters including maximum temperature, minimum temperature, rainfall and relative humidity were used for eight consecutive years (2009-2016).

Acute Diarrhea, Blood Diarrhea and Dengue analysis

National weekly data of acute diarrhea, blood diarrhea and dengue cases and corresponding meteorological parameters including maximum temperature, minimum temperature, rainfall and relative humidity were used for 10 consecutive years (2007-2016). Meteorological weekly data from each district are averaged to get national averages. Confounding variables like annual population, annual trend effect and

seasonal effect (Wet season: December – April; Dry Season: May – November)[36]. In dengue cases, national figures are modeled with exclusively Dilli meteorological conditions as most of the dengue cases were reported from the district alone (Needs reference for this statement).

2.7.3 Analysis

Descriptive analysis

Weekly (or monthly) data are used for descriptive analysis with graphical presentations and statistical modeling to observe the weekly (or monthly) and annual trends of the meteorological and health effect variables and associate between them through graphical analysis and statistical modeling. Variables other than meteorological variables used are trend effect (annual) variable and seasonal dummies (Wet season: December- April versus dry season: May-November).

Statistical modeling

Results of statistical modeling are obtained separately for the four districts and national estimates based upon the four districts in case of ARI, pneumonia and scabies modeling. In case of diarrhea and dengue modeling all the 10 districts of Timor-Leste have been used to obtain national estimates. Statistical modeling is carried out mainly to associate weather related variables and seasonal effects through negative binomial model (NB) and log-linear model. NB is the generalized linear model (GLM) with log link function suitable for over-dispersed count data. The model is used basically to account the over-dispersed nature of weekly reported ARI, pneumonia and dengue cases. NB model has been used to model separately for the four districts weekly data and dengue national weekly data whereas log-linear model was found suitable for aggregated data of the districts which is representative of the national scenario including the modeling of

[36] https://www.lonelyplanet.com/east-timor/weather; https://www.pacificclimatechangescience.org/wp-content/uploads/2013/06/5_PCCSP_East_Timor_8pp.pdf; https://www.thoughtco.com/east-timor-leste-facts-history-195753; .

acute diarrhea and blood diarrhea. For monthly data log-linear model is found suitable and used to associate between scabies cases and meteorological parameters.

Since incubation period of dengue virus is around 4 -10 days (WHO) same week and 1 week prior lag effects were combined through moving average (MA) and therefore effects are representative of the MA of the two weeks. Moreover, since incubation period of the common diarrheal pathogens are reported to be only few days only same week effect is considered for modeling. Predictors with *p* values less than 0.40 are shown in the results since predictors with *p* values greater than 0.40 are considered as very weakly associated with the dependent variable and therefore ignored. Estimates with 95% confidence intervals are shown in the results. Statistical software used for data modelling is SPSS version 24.

2.8. Identifying adaptation options

In order to identify and plan adaptation actions for Timor-Leste, review of literature including policy documents was carried out and these were discussed in stakeholder consultation meetings. Based on the feedbacks of stakeholders, a number of adaptation options were identified which will address likely health impacts of climate change. Based on the health impacts identified during the assessment, possible adaptation actions were compiled accordingly by going through the health sector plans and policies. This exercise ensured that adaptation actions are no ‘stand-alone’ measures that would need additional resources. Rather, by climate- proofing relevant activities of both plans, the adaptation actions proposed here can easily be mainstreamed into the sectoral planning and budgeting processes and cycles, as they are already part of existing health plans.

3. Health Vulnerability Assessment of Climate Change

Describing the current risks of climate-sensitive health outcomes, including the most vulnerable populations and regions

Direct impacts of climate change on human health include exposure to thermal extremes and damage to public health infrastructure, increased frequency of physiological disorder and injuries, due to the increase in frequency and/or intensity of extreme weather events. Indirect impacts include disturbances to ecological systems that result in changes to the geographical range and incidence of vector- borne diseases, infectious diseases, malnutrition and hunger that in turn disturb child growth and development. Sea level rises may also force population displacement and cause damage to infrastructure which will lead to increased susceptibility to infectious diseases and psychological disorders. Many infectious diseases such as malaria, dengue fever, diarrhea and other water and food borne diseases are found to be susceptible to climate change. Increasing temperatures may create more favourable conditions for vectors' development. Precipitation is another important factor that influences insect growth rates, especially mosquitoes and black flies because many of these species breed in the residual water that remains after flooding during the wet season. However, heavy rainfall may wash vector larvae away or kill them directly.

Extreme climate events such as storms and floods directly cause deaths and injuries, and can also have indirect effects on communicable diseases and livelihoods. Risk maps for extreme events have been developed "Disaster Risk and Hazard Map Analysis for Timor-Leste: An overview of existing risk maps" as a part of project entitled "Disaster Risk Management Institutional and Operational Systems Development in Timor-Leste", co-funded by UNDP and the Disaster Preparedness Programme of the European Commission's Humanitarian Aid department (DIPECHO). This study concludes that Timor-Leste faces high levels of exposure to disaster hazards and that

there are many vulnerable elements exposed to these hazards[37].

Natural disasters affected 951 per million people on average each year in Timor-Leste. Dili experiences on average eight tropical cyclones per decade, but their effect is weak[38].El Niño and La Niña have resulted in serious damage and disasters affecting different socioeconomic sectors of the country. Observations have indicated that El Niño events will become more frequent[39]. The International Disaster Database (emdat.be) reports that between the period 1990-2014 floods were responsible for 71.4% of disasters, with droughts and storms each responsible for 14.3% of disasters recorded. Floods were responsible for all of the reported mortality. The number of hazard events recorded during 2001-2011 for strong winds, floods and landslides reached 198, 150 and 38 events respectively, based on data from the Secretary of State of the Social Assistance and Natural Disasters. An average of 7,200 people each year are projected to be affected by flooding due to sea level rise between 2070 and 2100 [40].

Vector borne, airborne and waterborne diseases are a major category of climate-sensitive disease in Timor-Leste. Potential mosquito borne diseases include dengue, chikungunya and malaria. Enteric diseases are also an important category of climate sensitive health impact. The responsible pathogen for diarrhoea or gastroenteritis is usually not identified, but the main environmental health policy responses are common to most agents. Climate factors can alter enteric disease risks by affecting multiplication of the responsible pathogens in the environment (eg. salmonella) by contamination of water supplies (eg. via flooding) or by affecting the availability of sufficient, safe freshwater supplies.

Risk factors for protein-energy malnutrition and mortality in children include low birth weight, enteric and respiratory infections, lack of breastfeeding, short interval between

[37] Disaster Risk and Hazard Map Analysis for Timor-Leste: An overview of existing risk maps 2010. Disaster Risk Management Institutional and Operational Systems Development in Timor-Leste Project, UNDP

[38] Pacific Climate Change Science Program, 2011, Climate Change in the Pacific: Scientific Assessment and New Research, Volume 2: Country Reports, Chapter 3: East Timor, http://www.pacificclimatechangescience.org/publications/reports/report-climate-change-in-the-pacific-scientific-assessment-and-new-research/

[39] Secretariat for Environment, 2014, Timor Leste's Initial National Communication

[40] Climate and Health Country Profile – 2015: Timor-Leste. WHO & UNFCCC. 2015. Geneva.

successive births, adoption, overcrowding, and rural residence. Future nutritional health status and child mortality will depend on a wide range of social, demographic and economic trends as well as climate factors, but increases in extreme climate events are projected to have adverse impacts on food prices and food security globally.

Vulnerability is the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with, adverse impacts of climate change. Vulnerability can be described in relation to current conditions (contextual vulnerability) or in relation to specific causal pathways and future scenarios (outcome vulnerability). Contextual vulnerability is closely related to socioeconomic status.

The Initial Communication Report (INC) of Timor-Leste to UNFCCC undertook vulnerability assessment at the village (‘suco’) level by adopting the IPCC approach (IPCC 2001 and 2007) where vulnerability is measured using three dimensions, namely level of exposure, level of sensitivity and adaptive capacity. Hence, a system which has a high level of exposure and sensitivity with low adaptive capacity will be considered as a most vulnerable system while those with a low level of exposure and sensitivity with high adaptive capacity will be considered as less vulnerable.

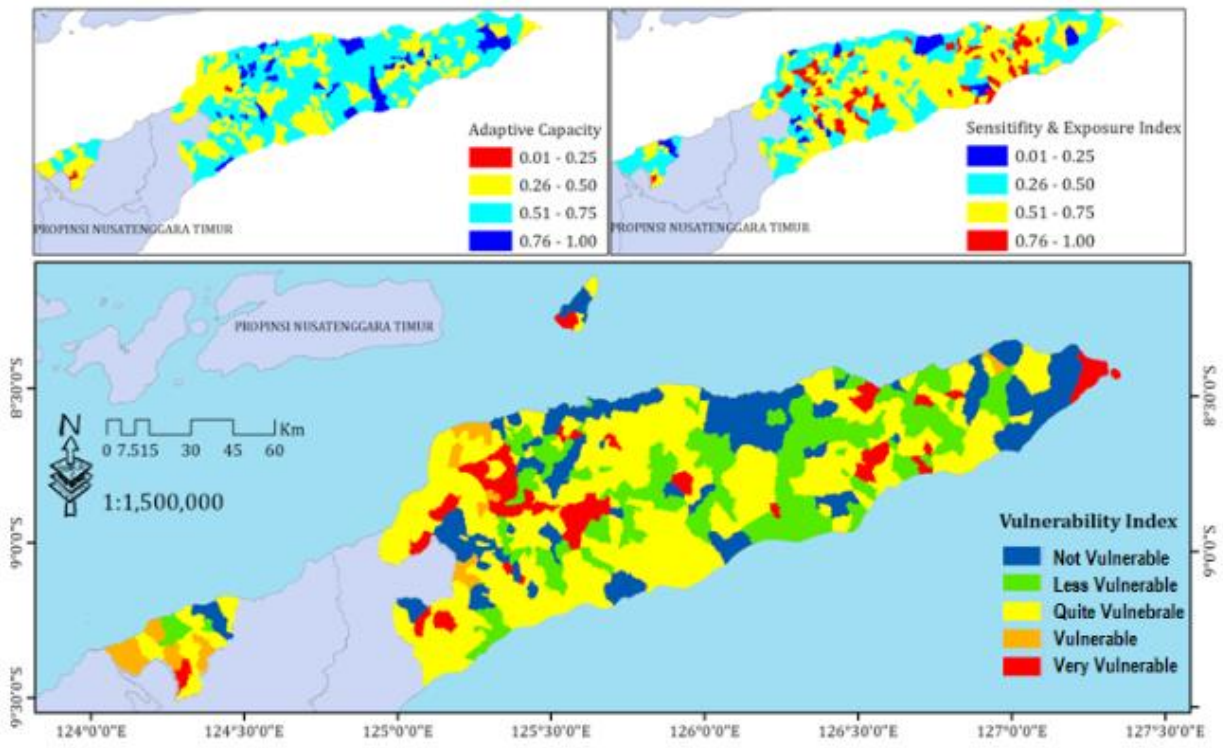

Figure 1: Vulnerability index of Timor-Leste by villages or "sucos" in 2010 (INC 2016)

In addition to the specific sub-national areas of vulnerability discussed above, overall, based on biophysical, social and economic data, 11.5% of sucos (villages) in Timor-Leste are categorized as very vulnerable to climate change, 44.7% categorized as quite vulnerable, and 2.9% are categorized as vulnerable[2]. The most vulnerable sucos mostly lie in the western part of the country, and improving the capacity of these sucos to manage climate risk in sectors such as agriculture and water has been identified by the government as a key part of the vulnerability reduction effort. Further assessment of climate change on key sectors is identified crucial to assist in identifying adaptation options in these sucos. The particular population groups that are especially vulnerable to specific climate-associated health risks are discussed above, and overall the most vulnerable groups are children, women and those with very low incomes.

The distribution of climate sensitive and other disease in different municipalities of Timor-Leste is provided in Table 2[41].

The number of reported dengue / dengue haemorrhagic fever (DHF) / dengue shock syndrome (DSS) cases increased by 120% in 2017, as compared with 2016. Most of the cases were reported from Dili, followed by Ermera, Lautem, Bononaro and Baucau. The number of reported dengue/DHS/DSS cases increased in January, peaked in February, started to decrease from March until July, and presented a minimal number of cases until the end of the year.

Acute upper respiratory infection (AURI) is the most reported disease and totalled 496,641 cases in all the municipalities in the year 2017. However, the number of cases decreased by 15% in the year 2017, as compared with 2016. More cases of AURI were reported in the first six months of the year. The number of cases decreased slightly after July, but still remained significant. The number of diarrhea cases increased in November till February. However, there are significant number of cases throughout of the year.

Diarrhea: The second most reported disease totalled as 80,674 cases in the year 2017. But the reported cases decreased by 27% in 2017, as compared with that of 2016. The number of cases increased in November till February. However, there are significant number of cases throughout of the year.

The number of scabies was 57,972, which is 57% increase in 2017 as compared with 2016. Similarly, there were 30 malaria cases diagnosed in 2017, as compared with 94 cases in 2016, with 68.1 % reduction.

[41] Epidemiological Bulletin for Timor-Leste. January 2018. Dili: Ministry of Health and WHO, Timor-leste

Table 2: The distribution of climate sensitive and other disease in different municipalities of Timor-Leste

Munisípiu/Municipalities	Aileu	Ainaro	Baucau	Bobonaro	Covalima	Dili	Ermera	Lautem	Liquica	Manatuto	Manufahi	Oecusi	Viqueque	TotalNo. kazuiha 2017	TotalNo. kazuiha 2016	Differensa
Epidemiamoraspregiu(prone)																
Dengue/DHF/DSS	0	0	16	23	3	409	51	42	0	1	3	0	4	552	251	120.0
Acute Upper Respiratory Infection	41,965	30,183		37,824	26,884	1,16,37	58,432	21,504	41,132	25,084	30,234	19,702	47,323	4,96,641	5,85,096	-15.2
Pneumonia	787	1,759		700	2,401	2,915	2,738	1,751	584	532	928	674	2,401	18,170	23,653	-23.2
Diarrhea	4,626	3,955		6,084	10,279	19,865	8,127	3,009	6,211	2,976	5,468	3,710	6,364	80,674	1,10,710	-27.1
Bloody diarrhea	149	68		331	132	600	297	193	126	88	35	173	475	2,667	4,217	-36.8
Cholera	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0
Meningitis/Encephalitis	0	0		0	25	0	0	0	0	0	0	13	0	38	0	0
Scabies	10,680	6,471		5,347	1,677	8,734	7,040	1,581	4,123	2,429	5,138	2,105	2,647	57,972	37,222	55.7

Source: Epidemiological Bulletin for Timor-Leste. January 2018. Dili: Ministry of Health and WHO, Timor-leste

4. Health Impact Assessment of Climate Change

Describing how the risks of climate-sensitive health outcomes, including the most vulnerable populations and regions, may change over coming decades, irrespective of climate change (2.3.2);

The most common health risks posed by climate change in Timor-Leste include Vector-borne diseases such as malaria and dengue, heat-related mortality, undernutrition, diarrhoeal diseases and disruption to health-care services due to extreme weather events[42]. Dengue and scabies cases seem increasing over the years. Malaria is currently well controlled, but may become more difficult to control as a result of increased travel, tourism, insecticide and drug resistance.

Extreme weather events such as flooding and other natural disasters often compromise the quality of potable water sources, leading to outbreaks of waterborne diseases such as diarrheal diseases[43]. More variable and extreme humidity and temperature levels have been linked to heat stress and more severe respiratory infections, such as pneumonia and upper respiratory tract infections. Indirect impacts include an increased risk of crop failure and livestock mortality, potentially undermining food security and increasing malnutrition rates.

Ministry of Social Solidarity (Disaster Operation Centre) has carried out integrated vulnerability and adaptation assessment at village level in five municipalities and planning to continue in other municipalities. The V&A assessment is also carried out for second national communication report and three districts are covered (Manatuto , Ermera Baucau) which shows that

[42] Framework for action in building health systems resilience to climate change in South-East Asia Region, 2017–2022. New Delhi: World Health Organization, Regional Office for South-East Asia; 2017.

[43] USAID. CLIMATE RISK IN TIMOR-LESTE: COUNTRY PROFILE. https://www.climatelinks.org/resources/climate-change-risk-profile-timor-leste

Higher temperatures and longer heatwaves are expected to increase the incidence of heat-related diseases, but district or village-level vulnerability assessments have not been undertaken. Under a high emissions scenario heat-related deaths in the elderly (65+ years) are projected to increase to about 39 deaths per 100,000 by 2080 compared to no estimated deaths during the baseline period between 1961 and 1990[44]. The elderly, children, those with chronic illness, the socially isolated and at-risk occupational groups are particularly vulnerable to heat and its health implications.

A detailed analysis of how these diseases may change in the absence of climate change is beyond the scope of this report (data were not made available), but could be carried out as part of subsequent work. The modeling of some climate sensitive diseases is done on this assessment depending on the availability of country data.

[44] Climate and Health Country Profile – 2015: Timor-Leste. WHO & UNFCCC. 2015. Geneva.

Estimating the possible additional burden of adverse health outcomes due to climate change (2.3.3).

Climate change will tend to exacerbate projected underlying disease trends, especially for diarrhoeal illness, air-borne diseases, skin diseases and vector borne diseases.

Relationship between Pnemonia, ARI and climatic variables

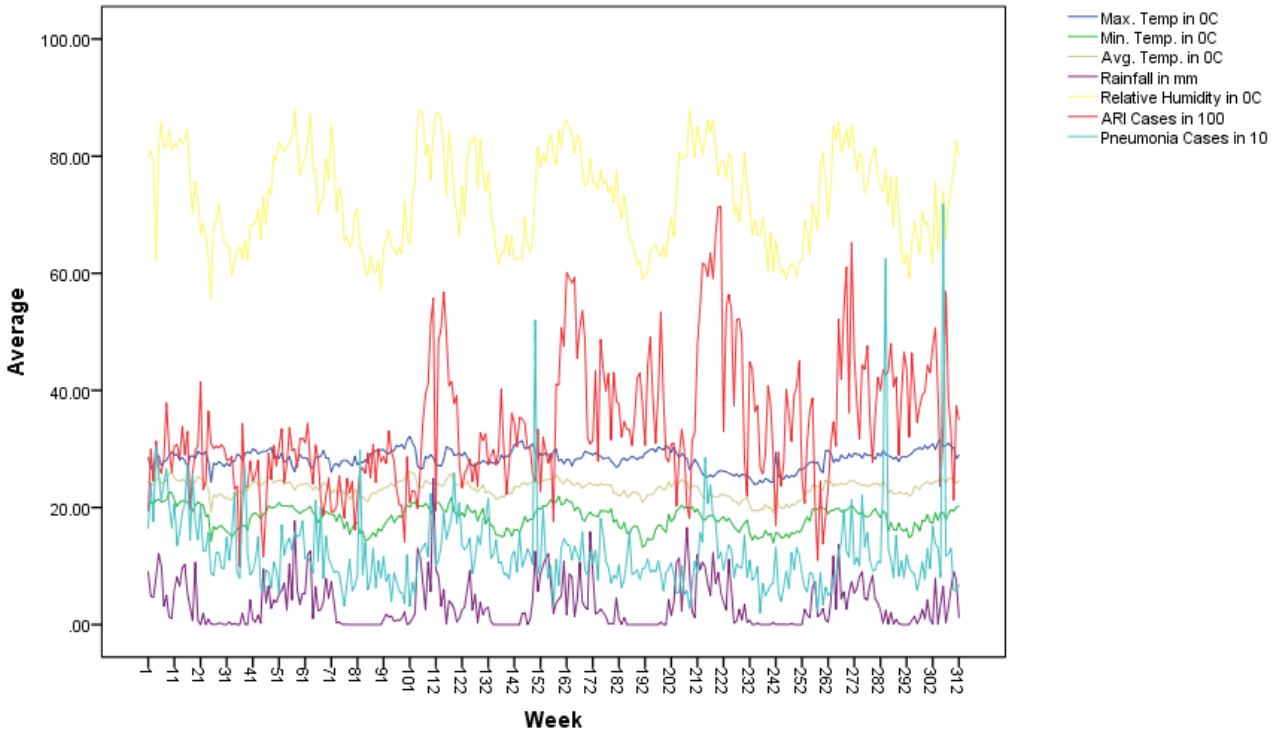

Figure 2: National weekly averages of ARI and Pneumonia cases and corresponding meteorological parameters, Timor-Leste, 2011-2016

Relationship between Scabies and climatic factors

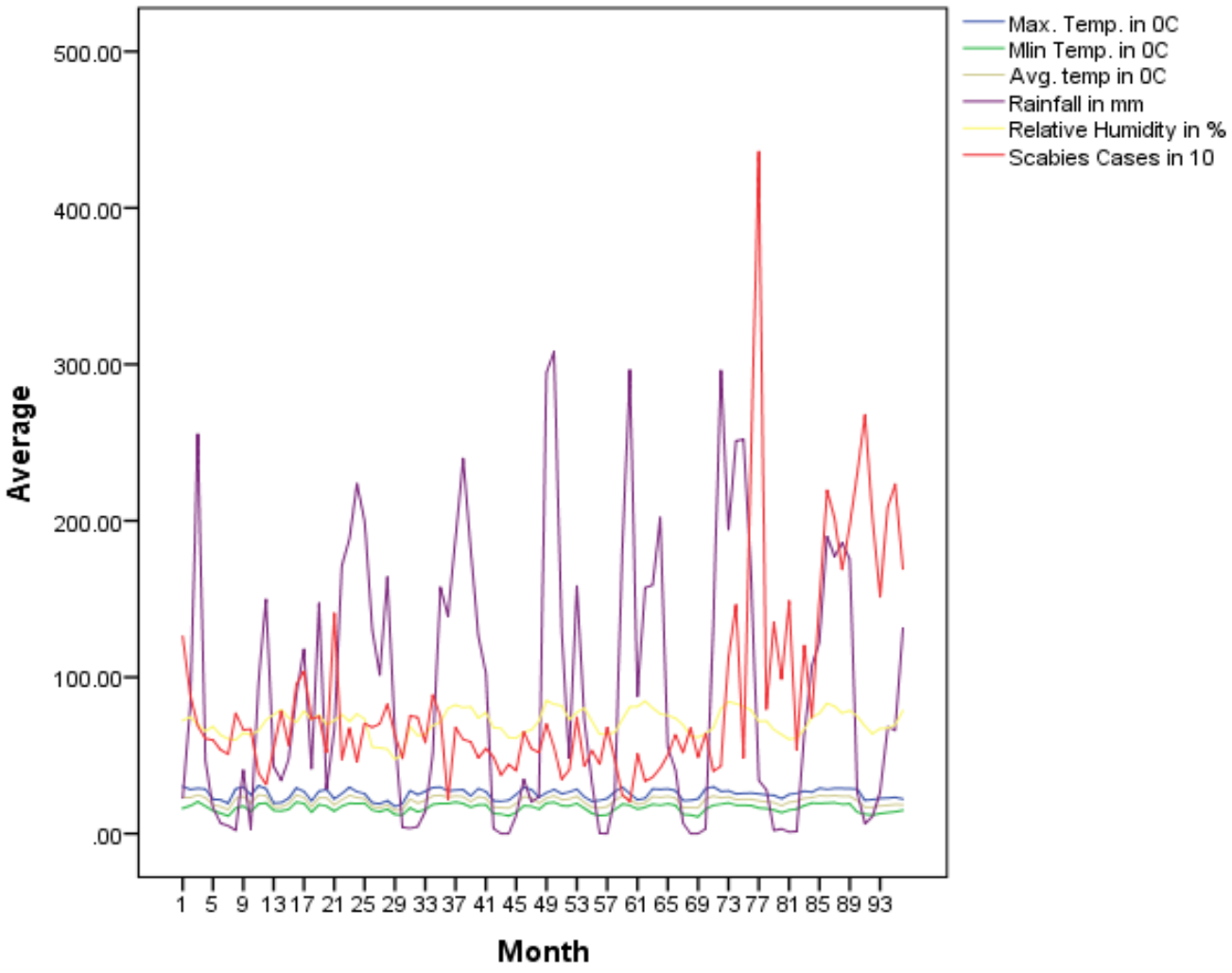

Figure 3: National monthly averages of Scabies cases and corresponding meteorological parameters, Timor-Leste, 2009-2016

Relationship between diarrheal diseases and climatic factors

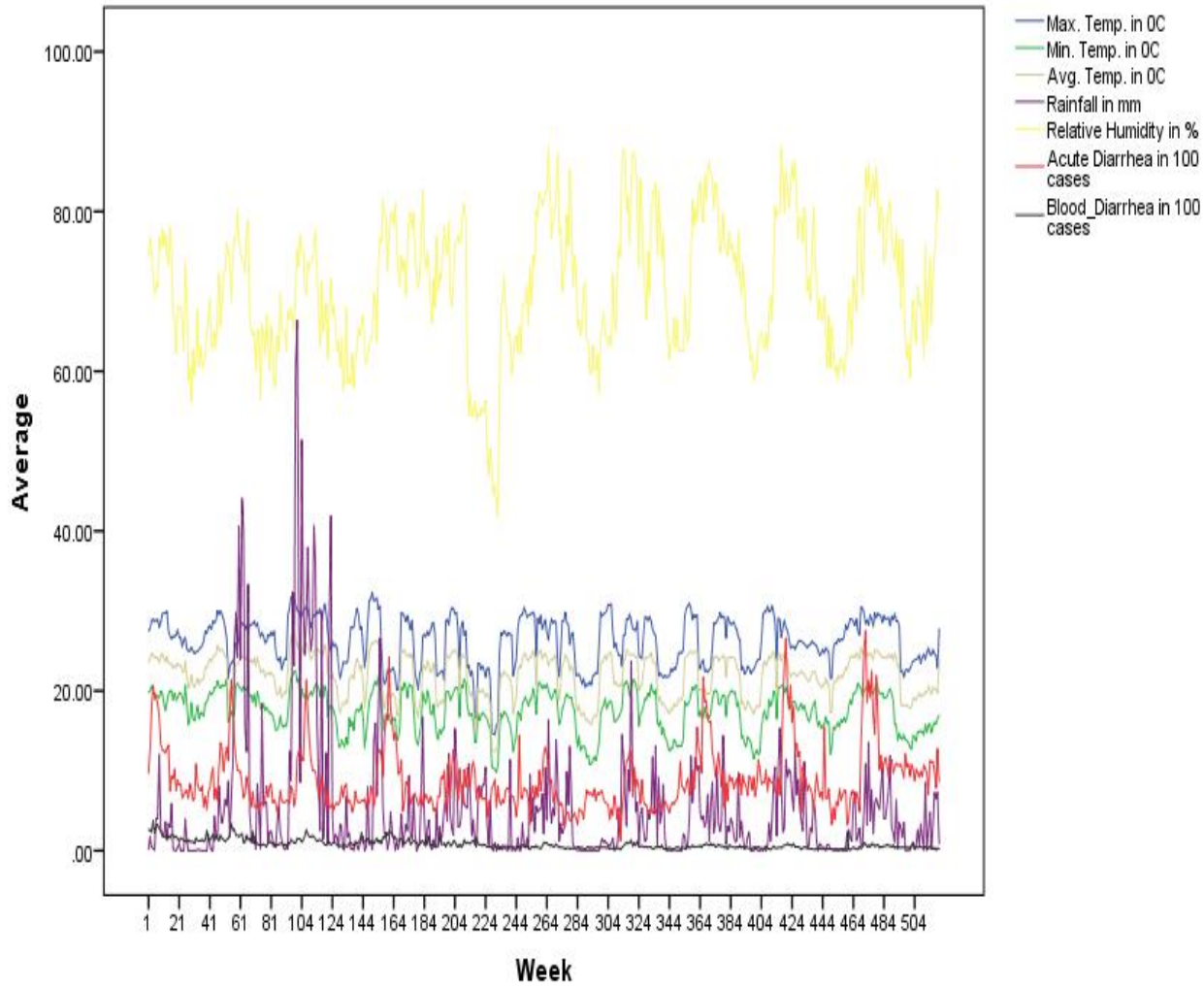

Figure 4 National weekly averages of diarrheal cases and corresponding meteorological parameters, Timor-Leste, 2007-2016

Relationship between dengue and climatic factors

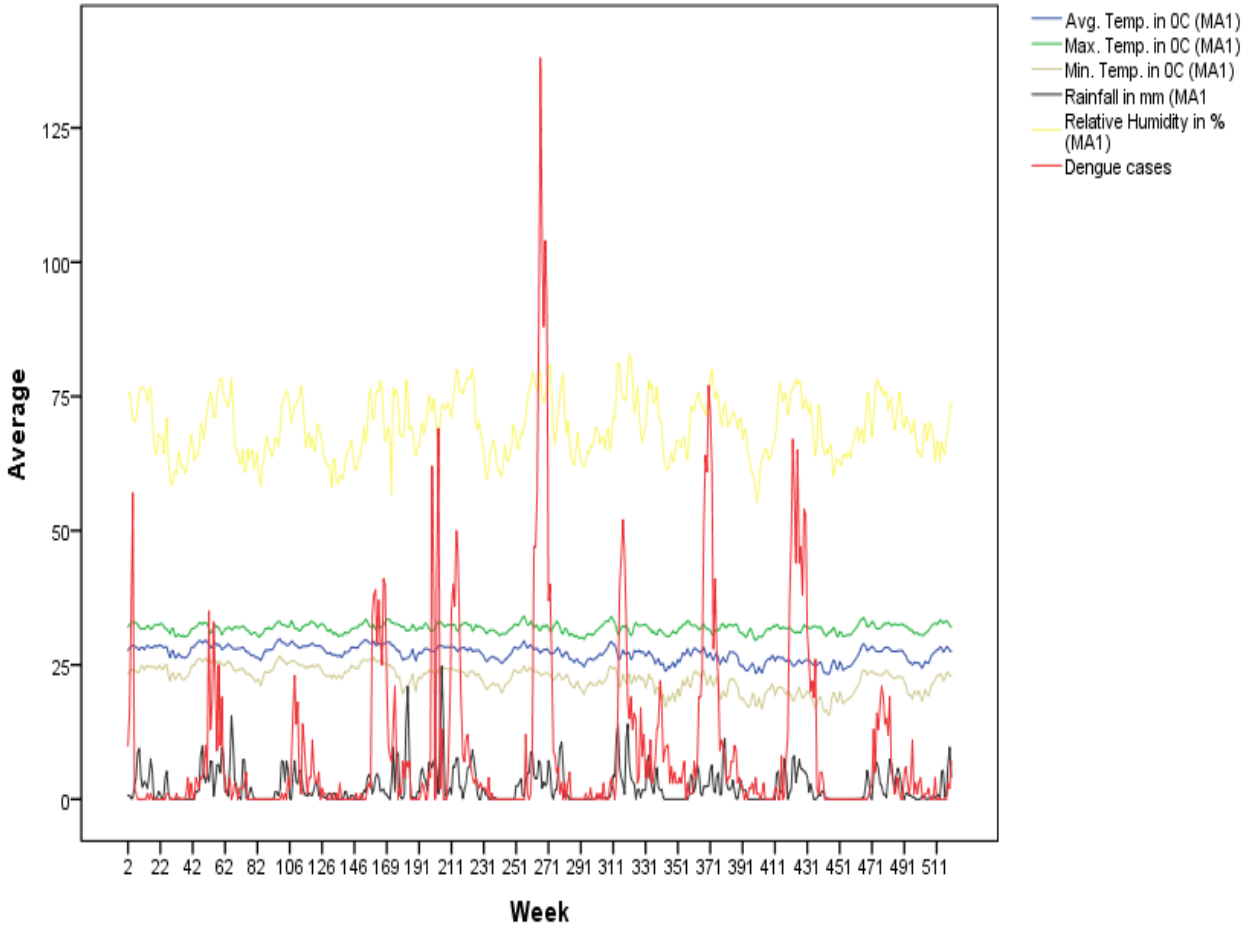

Figure 5: National weekly averages of dengue cases and corresponding meteorological parameters, Timor-Leste, 2007-2016 (using Dilli meteorological averages and MA Lag 1 effect)

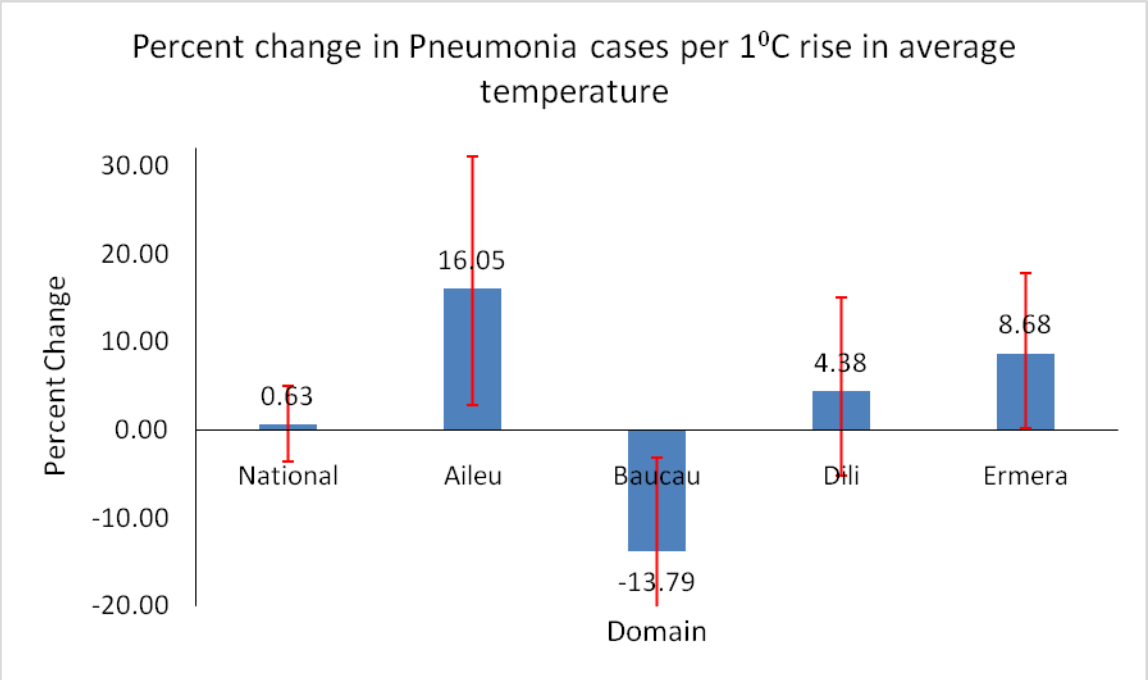

Figure 6: Percent change in Pneumonia cases per 1^{0}C rise in average temperature

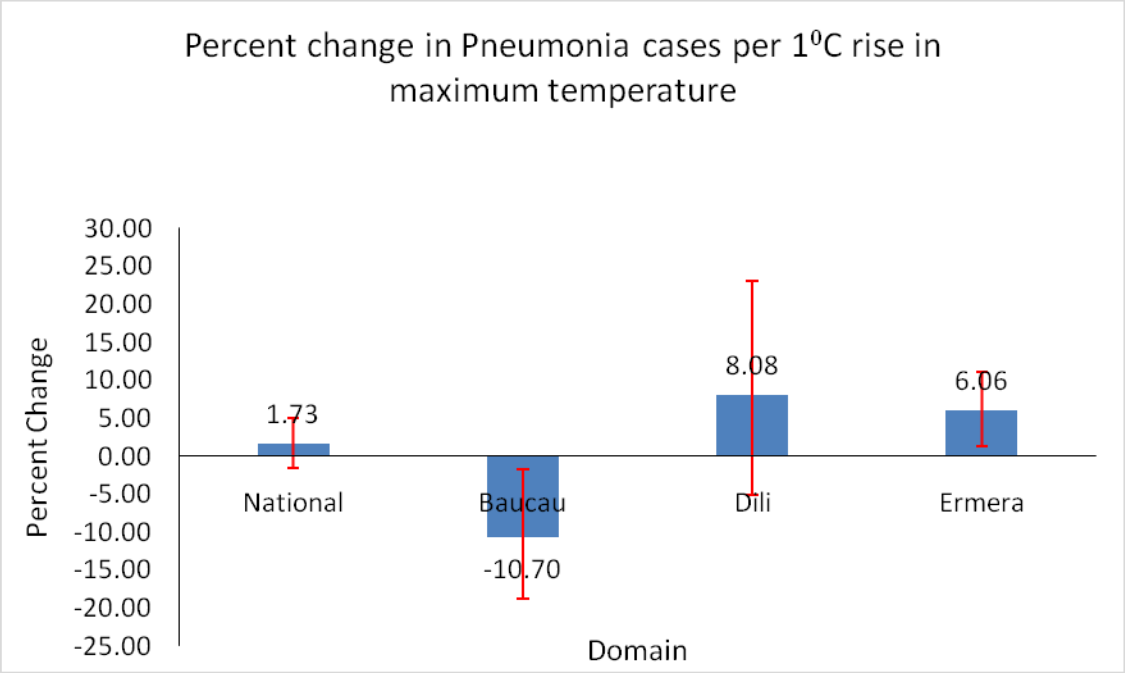

Figure 7: Percent change in Pneumonia cases per 1^{0}C rise in maximum temperature

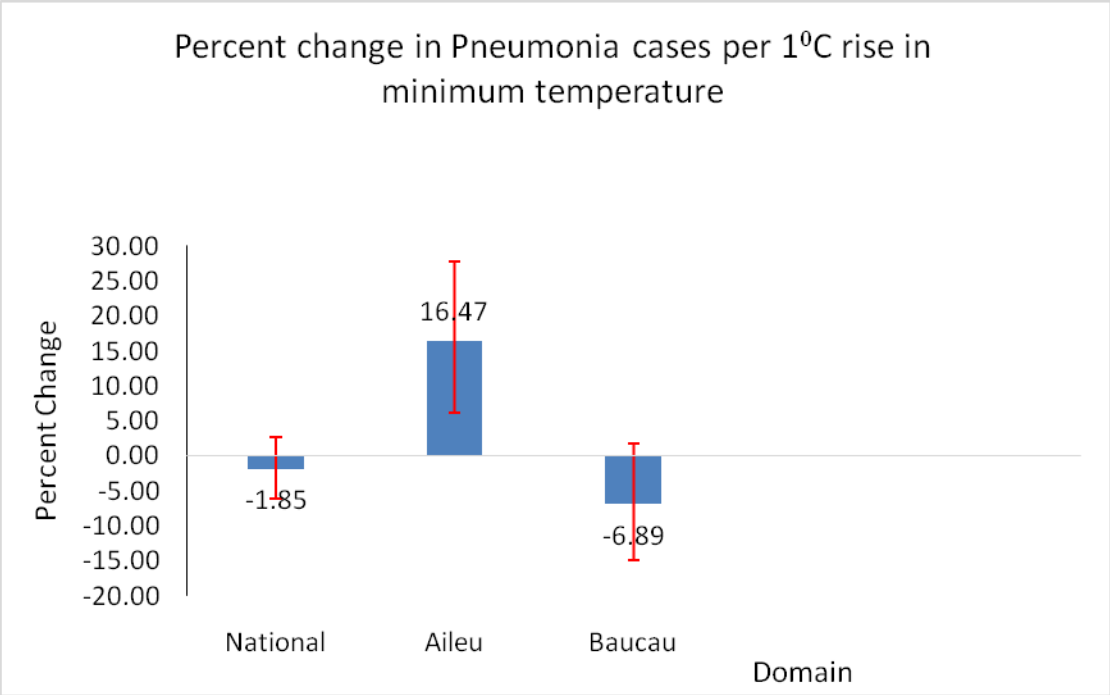

Figure 8: Percent change in Pneumonia cases per 1^{0}C rise in minimum temperature

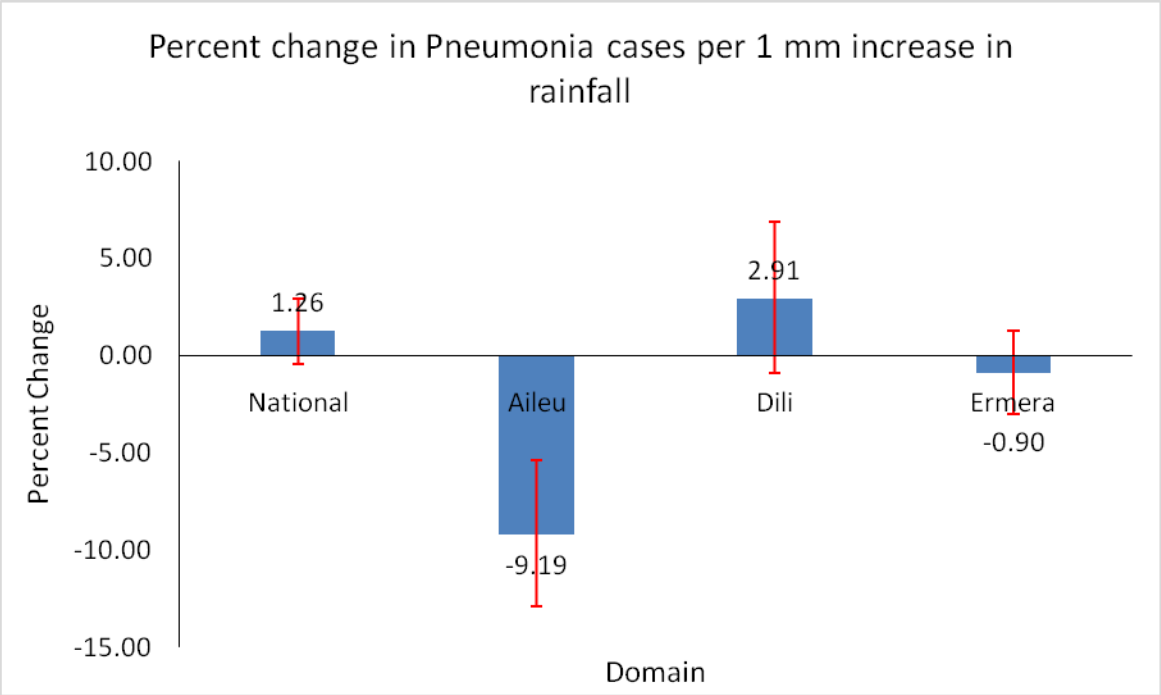

Figure 9: Percent change in Pneumonia cases per 1 mm increase in rainfall

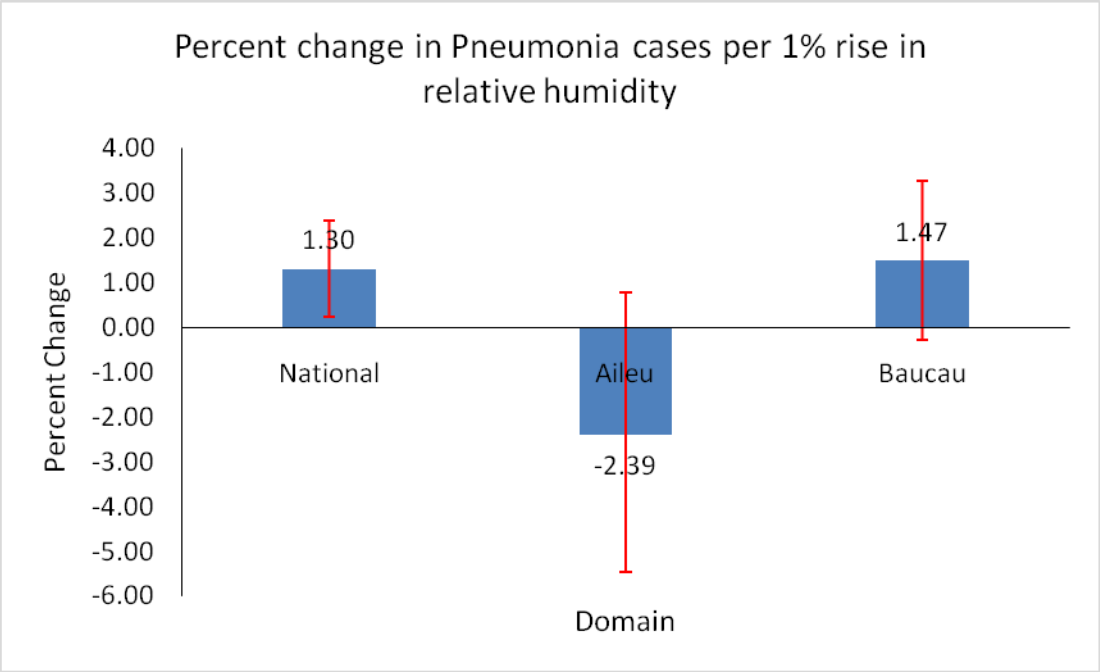

Figure 10: Percent change in Pneumonia cases per 1% rise in relative humidity

Relationship between ARI and climatic factors

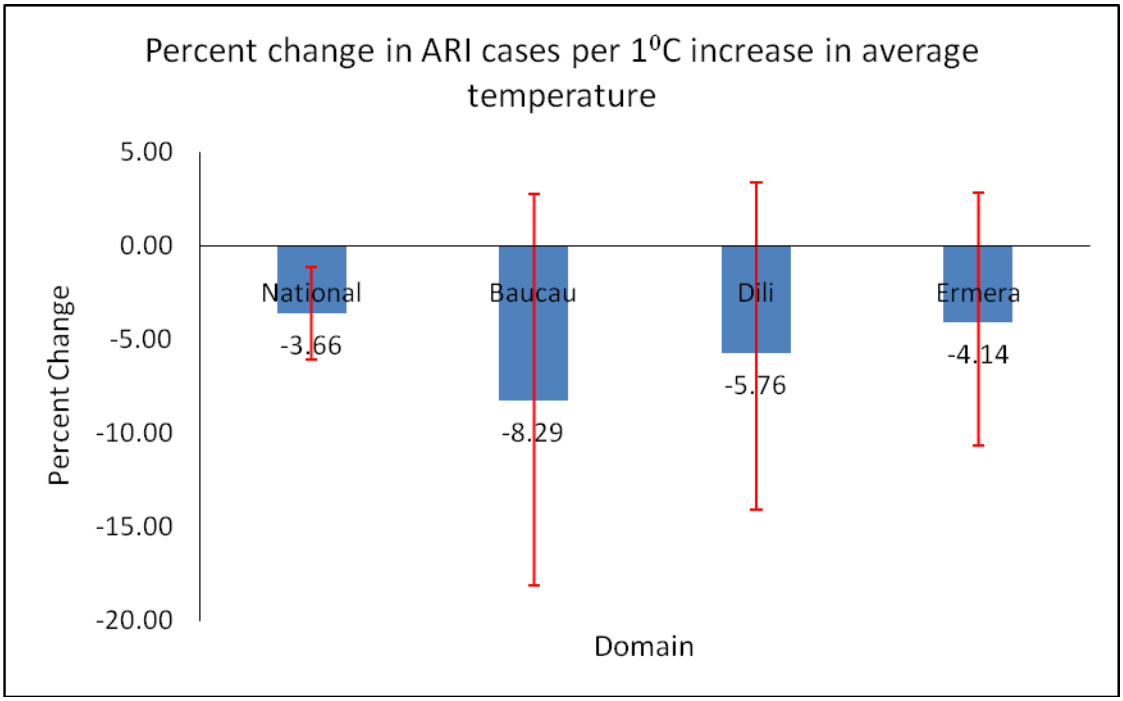

Figure 11: Percent change in ARI cases per 1^{0}C increase in average temperature

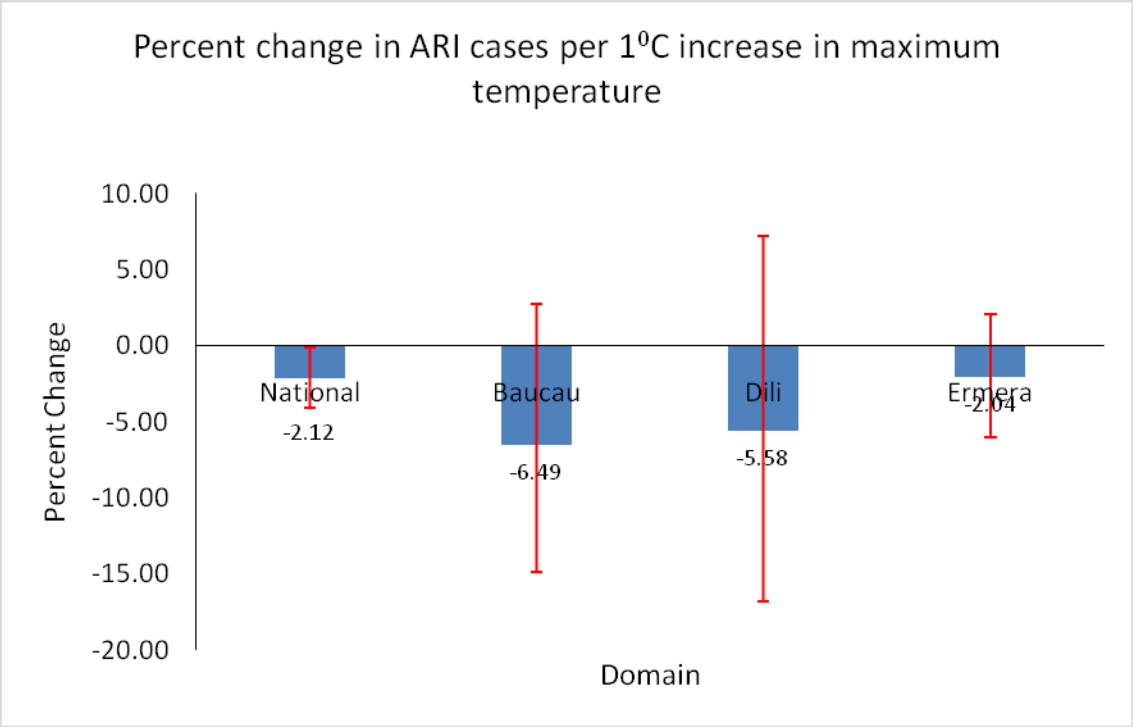

Figure 12: Percent change in ARI cases per 1^{0}C increase in maximum temperature

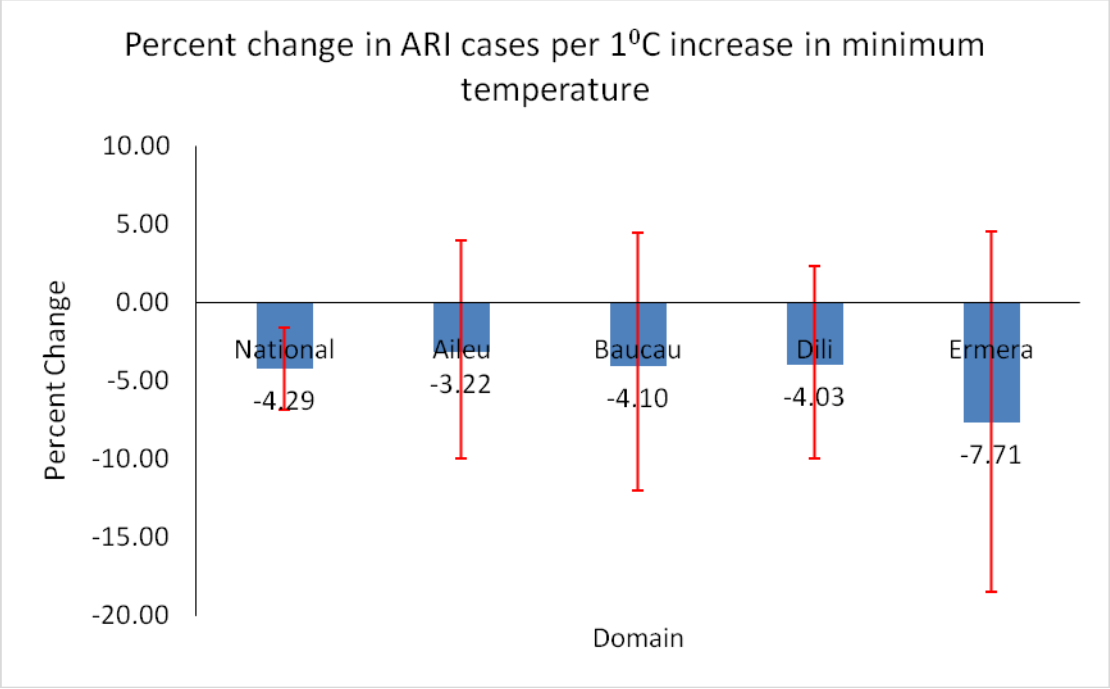

Figure 13: Percent change in ARI cases per 1^{0}C increase in minimum temperature

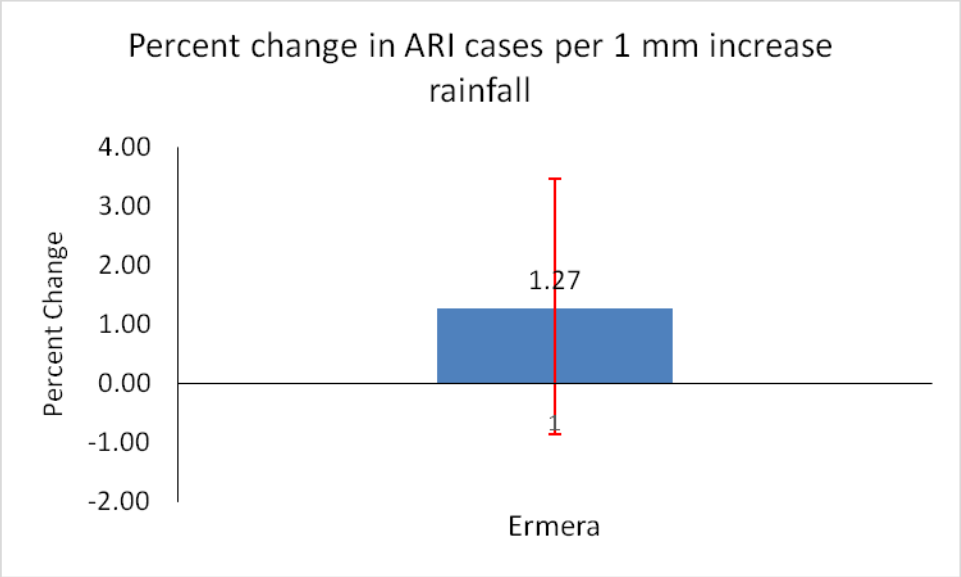

Figure 14: Percent change in ARI cases per 1 mm increase rainfall

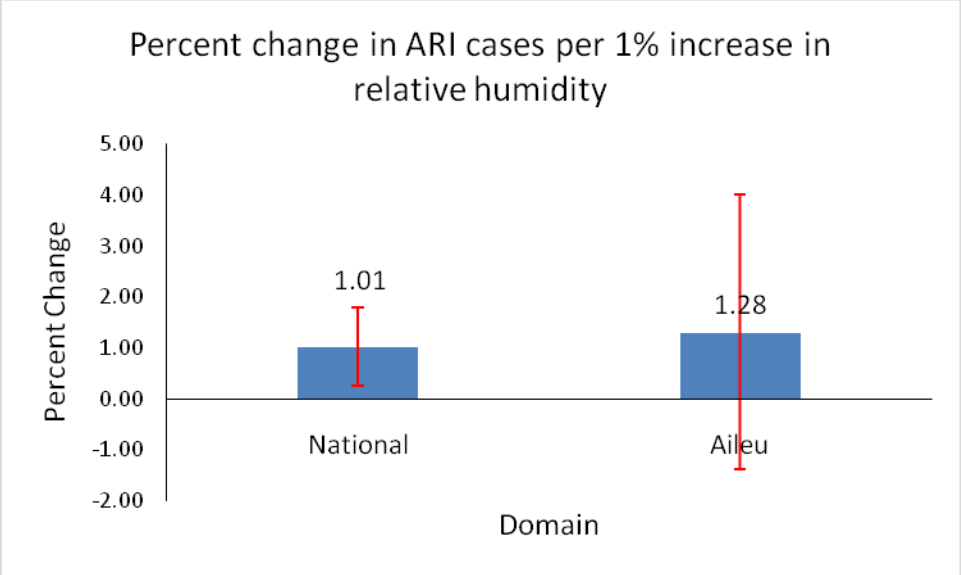

Figure 15: Percent change in ARI cases per 1% increase in relative humidity

Relationship between Scabies and Climatic factors

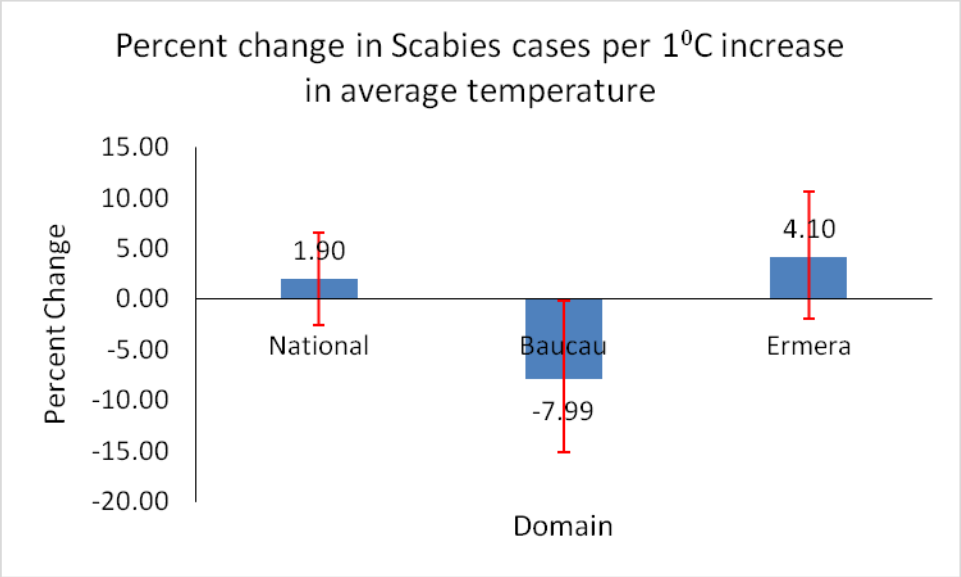

Figure 16: Percent change in Scabies cases per 1^0C increase in average temperature

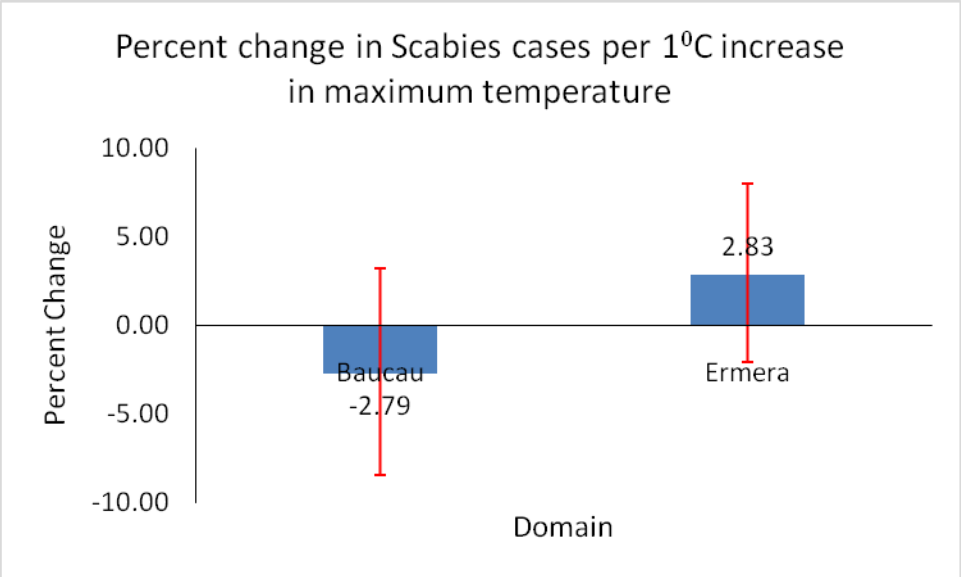

Figure 17: Percent change in Scabies cases per 1^0C increase in maximum temperature

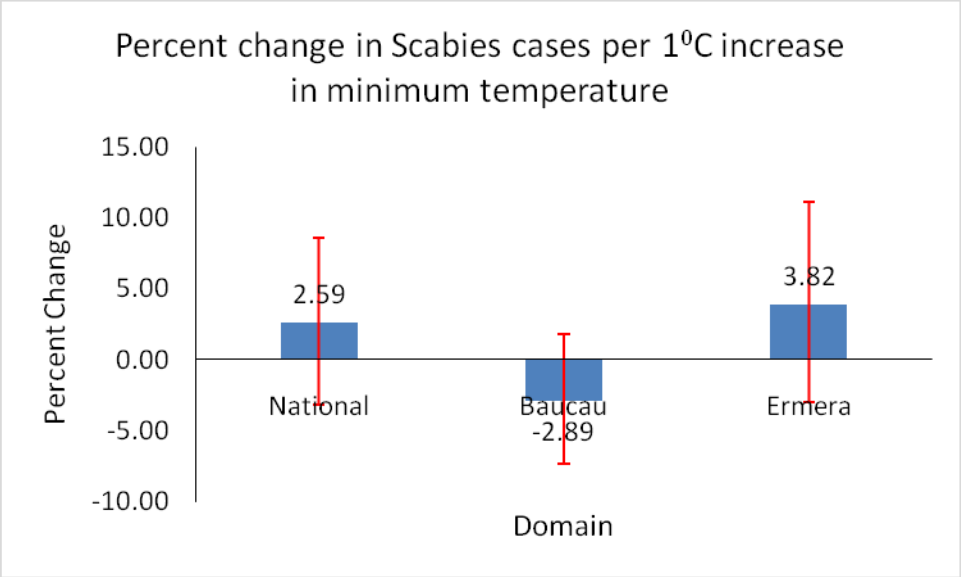

Figure 18: Percent change in Scabies cases per 1^0C increase in minimum temperature

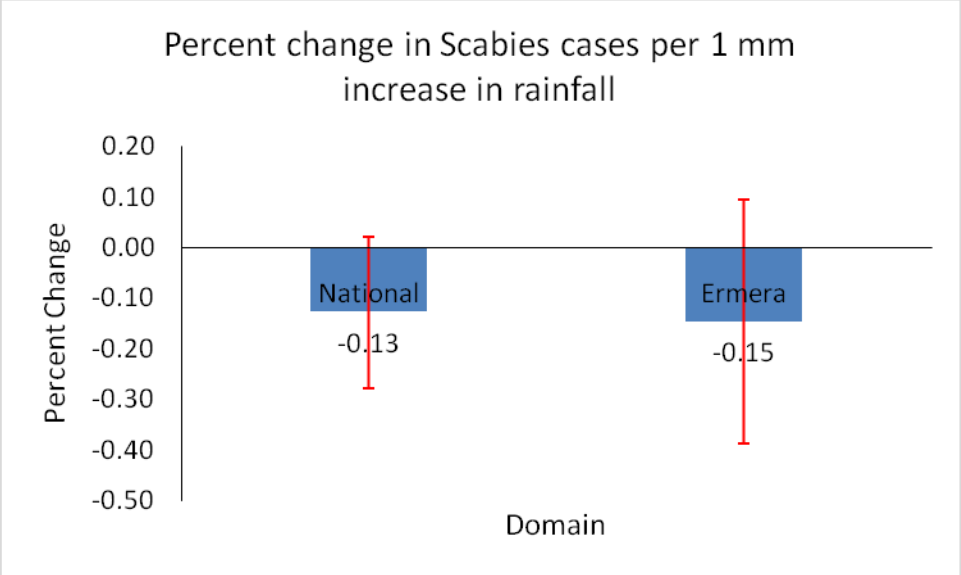

Figure 19: Percent change in Scabies cases per 1 mm increase in rainfall

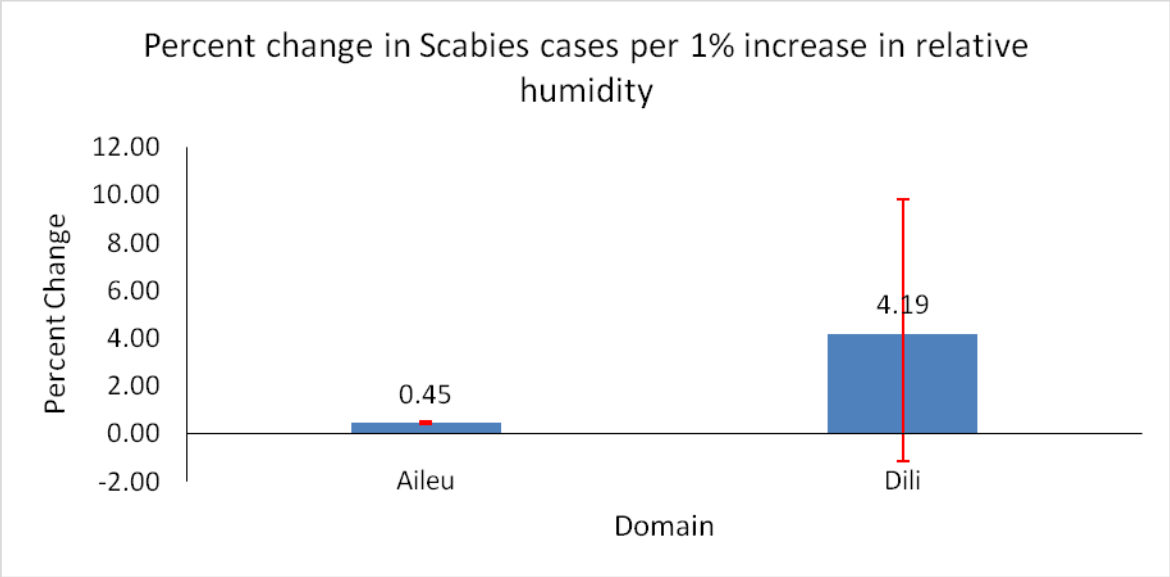

Figure 20: Percent change in Scabies cases per 1% increase in relative humidity

Relationship of Diarrhea and Dengue with climatic factors

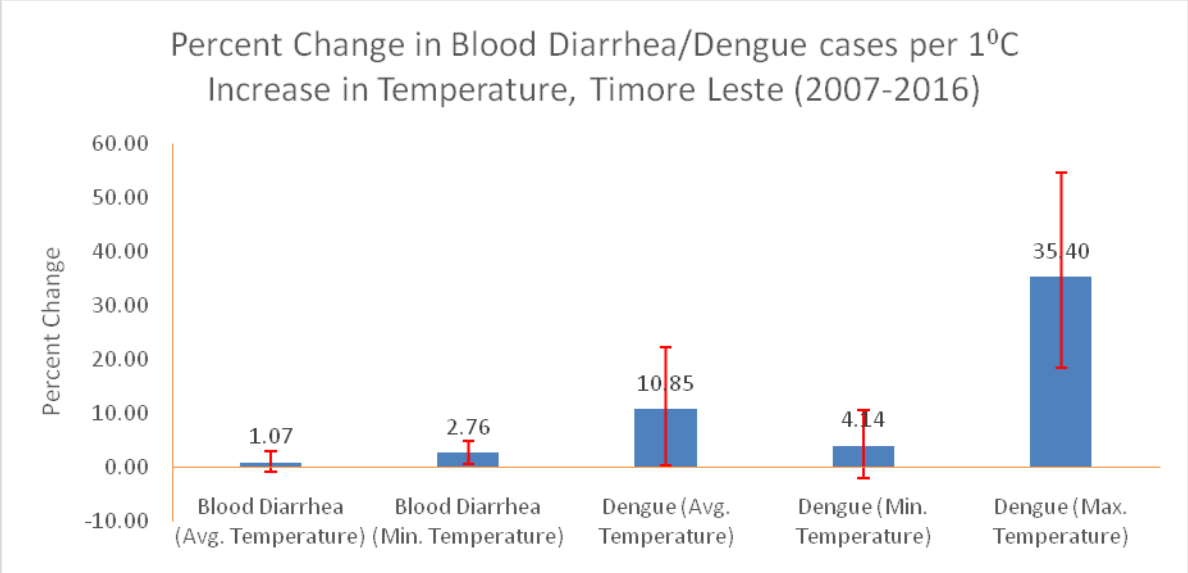

Figure 21: Percent Change in Blood Diarrhea/Dengue cases per 1^0C Increase in Temperature, Timore Leste (2007-2016)

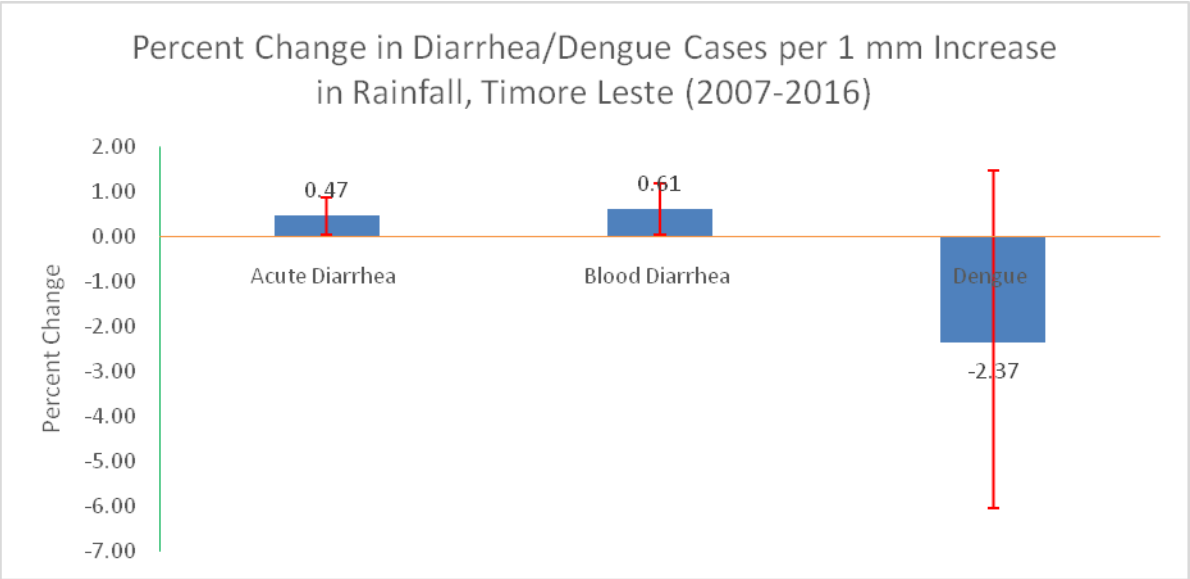

Figure 22: Percent Change in Diarrhea/Dengue Cases per 1 mm Increase in Rainfall, Timore Leste (2007-2016)

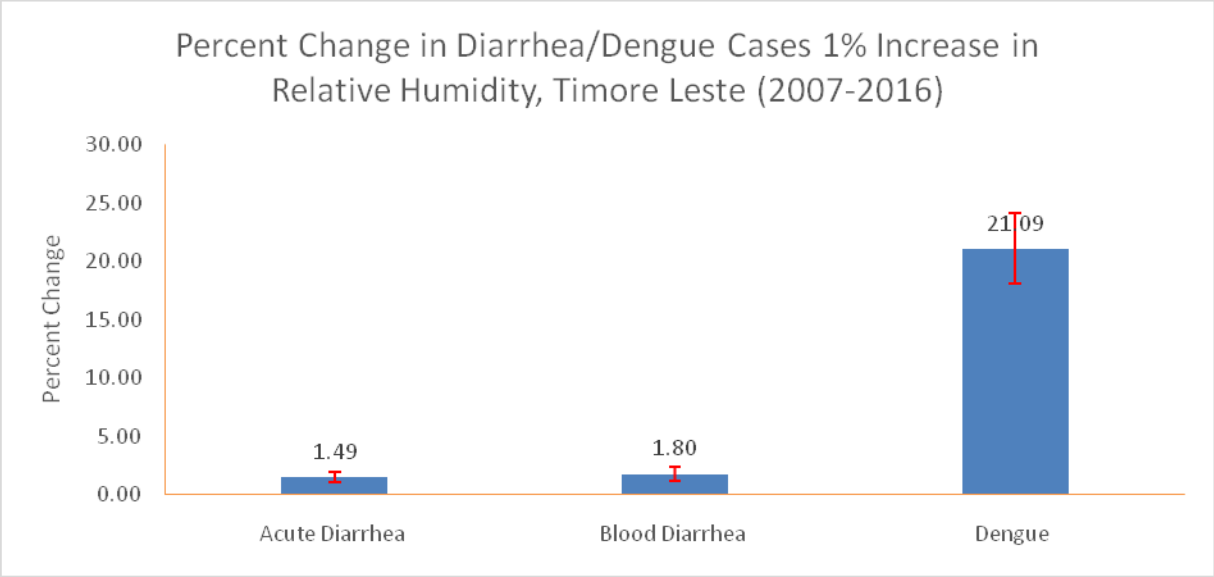

Figure 23: Percent Change in Diarrhea/Dengue Cases 1% Increase in Relative Humidity, Timore Leste (2007-2016)

Interpretation of relationship between climate sensitive diseases and climatic factors

Temperature effects

Effect of temperature on pneumonia incidence even though found slightly positive with 0.63% rise per 1 ^{0}C increase in average temperature is not statistically significant at 5% level. In contrast to effect of average and maximum temperature effects, decrease in minimum temperature is found with increase in pneumonia incidence in Timor-Leste with negative association. District-wise separate effects of temperature are also not consistent on pneumonia incidence.

Decrease in temperature (average, maximum and minimum) is found to increase ARI occurrence with 3.66% (95% CI: 1.16-6.1%) decrease per 1^{0}C increase in average temperature and statistically significant at 5% level. The effects are relatively much consistent compared to effects on pneumonia.

Overall increase in temperature (average and minimum) is found to be associated with increase in scabies incidence with p value < 0.4 though statistically insignificant at 5% level with 1.9% rise in the scabies cases per 1^{0}C increase in average temperature. However, the association is found to be negative in case of maximum temperature which is an indication of variability in the nature of association and also inconsistent associations and may need further research in this area.

Effects of temperature on acute diarrhea is found to be highly insignificant with high p values. In case of blood diarrhea, average and minimum temperature is found positively associated with 1.07% rise in blood diarrhea per 1^{0}C rise in average temperature whereas maximum temperature is found highly insignificant.

Rise in temperature (average, maximum and minimum) is found to increase dengue occurrence with relatively high effects size since 10.85% (95% CI: 0.39-22.4%) rise in dengue incidence per 1^{0}C increase in average temperature is detected and the directional effects seems to be consistent as well though not in its magnitude.

Effects of rainfall

Effects of rainfall occurrence on pneumonia incidence does not show strong evidence of association though found positively associated overall with 1.26% rise in pneumonia cases per 1mm increase in rainfall but not statistically significant at 5% level.

Effects of rainfall on ARI incidence is found highly statistically insignificant except in Ermera where 1.27% increase in ARI cases is detected per 1 mm rise in rainfall which is statistically insignificant at 5% level.

Scabies incidence is found slightly negatively associated with rainfall with 0.13% decrease in scabies occurrence with 1mm increase in rainfall though statistically insignificant 5% level.

Acute diarrhea and blood diarrhea tends to increase with occurrence of rainfall with 0.47% (95% CI: 0.05-0.89%) and 0.61% (95% CI: 0.04-1.19%) increase in acute and blood diarrhea per 1mm increase in rainfall, respectively and both the effects being statistically significant at 5% level. However, rainfall is found to be associated negatively with dengue occurrence but the effect is statistically insignificant at 5% level.

Effects of relative humidity

Relative humidity is found to effect positively pneumonia incidence with 1.3% (95% CI: 0.24-2.37%) increase in pneumonia incidence per 1% increase in relative humidity which is statistically significant at 5% level.

Relative humidity is found to effect positively ARI incidence with 1.01% (95% CI: 0.24-1.79%) increase in ARI incidence per 1% increase in relative humidity which is statistically significant at 5% level.

Though found positive association between scabies incidence and relative humidity in Aileu and Dilli districts, the overall effect of relative humidity on scabies cases is found to be highly insignificant with p value >0.4.

Acute diarrhea and blood diarrhea are found to be strongly associated with relative humidity with 1.49% (95% CI: 1.06-1.91%) and 1.8% (95% CI: 1.18-2.43%) rise in acute diarrhea and blood diarrhea per 1% increase in relative humidity, respectively and the effects are found to be statistically significant at 5% level. Moreover, the effect of relative humidity on dengue occurrence is found even stronger with much larger effects size with 21.09% (95% CI: 18.10-24.15%) increase in dengue per 1% increase in relative humidity and the effect is statistically significant at 5% level.

Projection of risks of malaria and dengue

In Timor-Leste malaria is still ranked among the leading causes of mortality and morbidity. Dengue is also quite serious but not as bad as malaria. This study assessed the potential impact of climate change on the risk of malaria and dengue. The level of risk is defined by the incidence rate and transmission risk. The incidence rate is classified into five categories, 1-5. Locations that have an incidence rate of more than the lowest four quintiles of the incidence rate across all sites are categorized as sites with the highest incidence rate (score equal to 5). Transmission risk is determined by climate factors namely temperature and rainfall. The transmission risk will change when there are changes to temperature and rainfall. Categorization of locations based on transmission risk also consists of five categories defined similarly to incidence rate. Thus the level of climate risk for malaria and dengue would be considered very-very high(VVH) if both the incidence rate and the transmission risk of the districts are equal to 5.

Deaths due to malaria are among the leading causes of mortality and morbidity in Timor-Leste and are reported as 16.2 per 100,000 people 3. By 2070, under both high and low emissions scenarios about 2.76 million people in Timor-Leste are projected to be at risk of malaria, an increase from about 600,000 people at risk annually during the baseline period of 1961-1990 10. In recent years, the activities of the Ministry of Health’s National Malaria Control Programme, including the widespread introduction of Rapid Diagnostic Test kits, improved surveillance, distribution of insecticide-treated nets and indoor residual spraying, have proved highly effective in reducing malaria incidence

in Timor-Leste. The country is nearing malaria elimination, and may pursue elimination in the coming years as part of a Global Fund project.

Modelling of climate change impacts on dengue and malaria in Timor-Leste suggests that the number of districts at high risk may increase in the future, however after 2040 it might decrease[45]. Currently, Manatuto district has the highest dengue risk, while Viqueque and Lautem have the highest malaria risk.

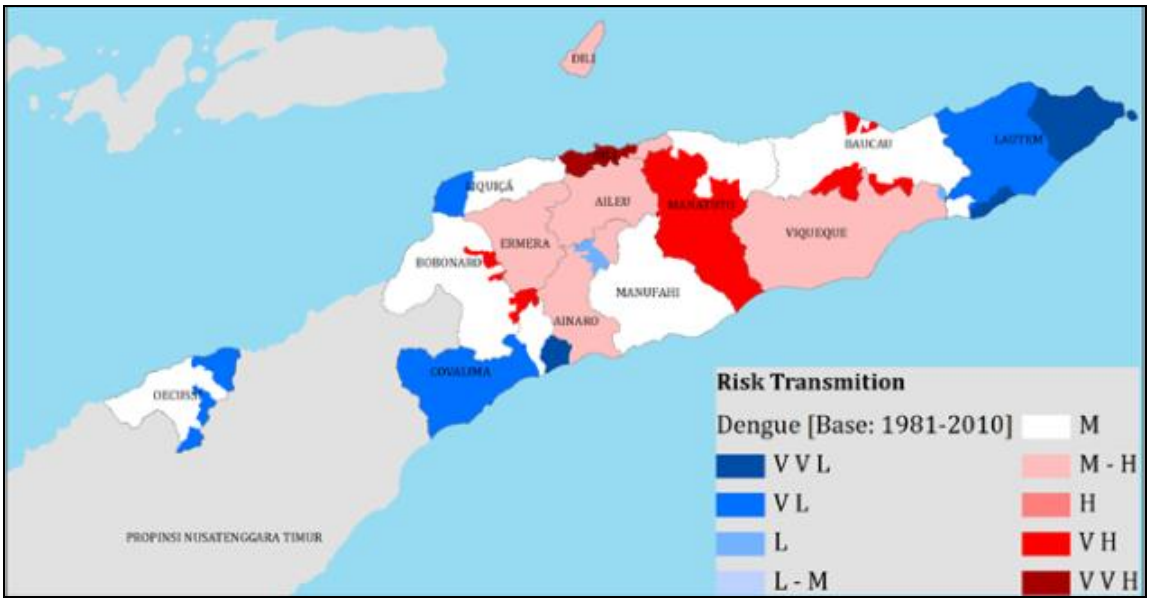

Figure 24: Level of risk for dengue fever in Timor-Leste under current climate conditions

[45] Secretariat for Environment, 2014, Timor-Leste's Initial National Communication

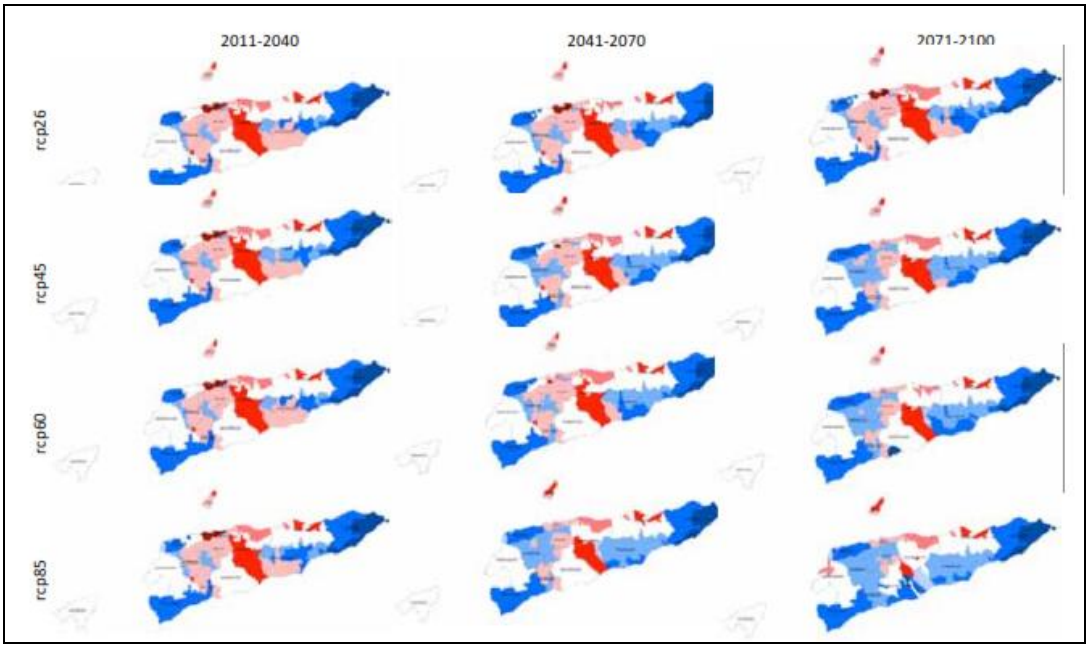

Figure 25: Level of risk for dengue in Timor-Leste under future climate

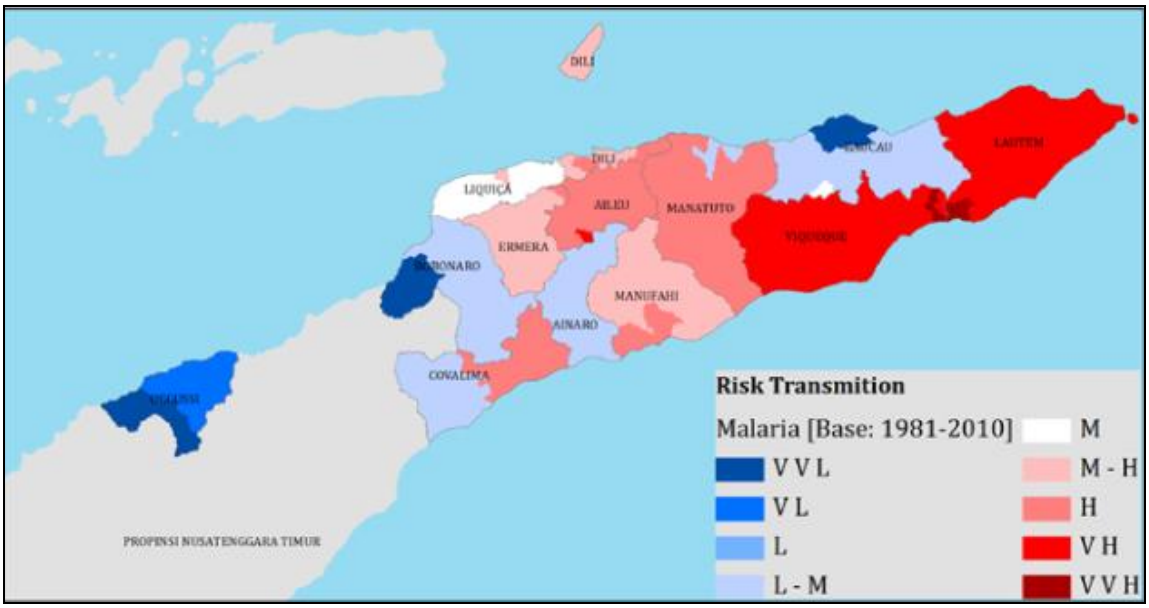

Figure 26: Level of risk for Malaria in Timor-Leste under current climate conditions

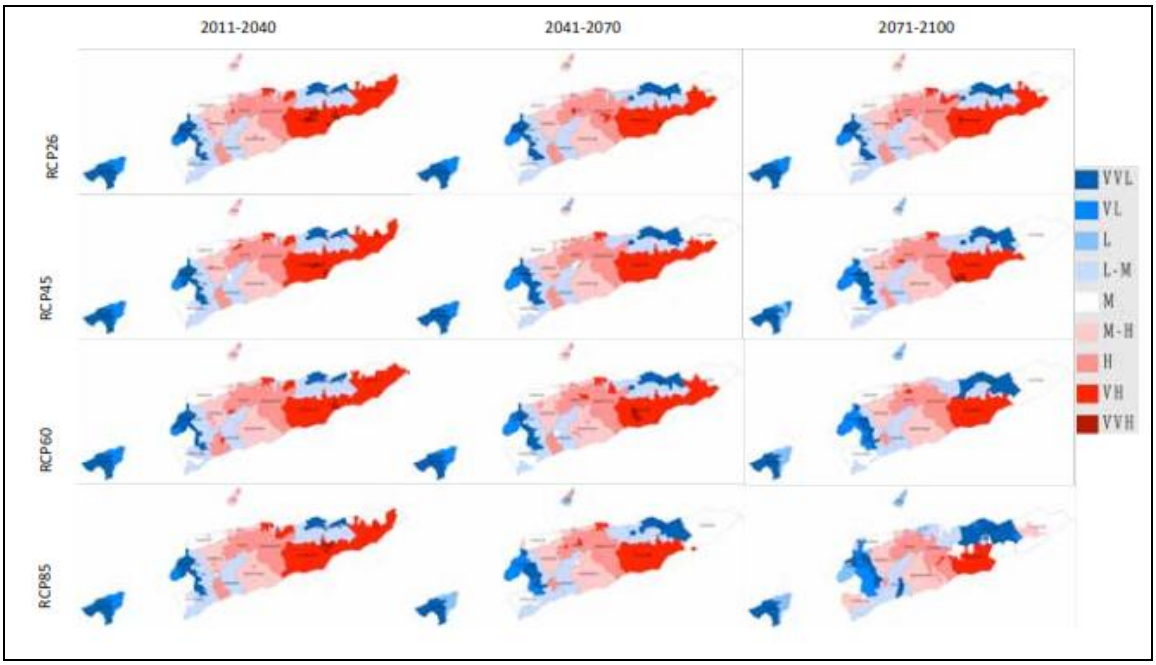

Figure 27: Level of risk for Malaria in Timor-Leste under future climate

The direct and indirect impacts of climate variability and change on human health in Timor-Leste listed above are important considerations to take into account when assessing Timor-Leste's vulnerability and discussing adaptation needs.

1. Public Health Adaptation Assessment to Climate Change

Identify and prioritize policies and programmes to address current and projected health risks (2.4.1);

Important progress has also been made in strengthening health systems in Timor-leste. In recent years the Ministry of Health of Timor-Leste has increased its capacity for planning, budgeting, monitoring and evaluation, and has formulated key national policies and standards while continuing to build capacity of human resources[46]. A number of guidelines and norms has also been formulated for logistics to deliver quality essential medicines and technologies, and in collaboration with partners and stakeholders has increased the capacity for inter-sectoral coordination and harmonization and alignment of international cooperation and partnerships. However, there is need to mainstream climate change component in developing policies and programmes on climate sensitive diseases and risks. There is also a need for further ensuring the systematic evaluation of impacts of health technology and interventions (using economic, organizational and social analysis, among others) to inform evidence-based policy decision-making, especially on how best to allocate resources for health interventions and technologies in support of the efforts to reach universal health coverage of quality adapted health services in Timor-Leste.

Timor-Leste National Adaptation Programme of Action (NAPA) to Climate Change (2010)[47] has an overarching vision to make the Timorese people more resilient to climate change, recognizing their high vulnerability in an economy that is dominated by subsistence agriculture. The identified adaptation measures are focused on reducing the adverse effects of climate change and promote sustainable development. These

[46]WHO Country Cooperation Strategy, Timor-Leste, 2015-2019
[47] Democratic Republic of Timor-Leste, Ministry for economy and development,Secretary of state for environment Secretariat of the Environment. Timor-Leste National Adaptation Programme of Action (NAPA) on Climate Change (2010)

measures will build on existing strategies and plans across all sectors within Timor-Leste including the National Priorities process. The following priority adaptation measures are proposed by Timor-Leste in its NAPA (2010)

2. Food Security: Reduce t he vulnerability of farmers and pastoralists to increased drought and flood events.
3. Water Resources: Promote Integrated Water Resource Management (IWRM) to guarantee water access in a climate change context.
4. Human Health: Enhance t he capacity of the health sector and communities to anticipate and respond to changes in distribution of endemic and epidemic climate-sensitive diseases, and reduce the vulnerability to infection of populations in areas at risk from expansion of climate-related diseases.
5. Natural Disasters: Improve institutional and community (including vulnerable groups such as women and children) capacity to prepare for and respond t o climate change induced natural disasters.
6. Forests, Biodiversity and Coastal Ecosystems: Maintain and restore mangrove and forests and promote awareness raising to protect coastal ecosystems and forests from climate change impacts.
7. Livestock Production: Improve planning and legal framework for the promotion of sustainable and balanced food for livestock production.
8. Physical Infrastructure: Improve regulations, standards and compliance for cl i mat e-resilient infrastructure.
9. Supporting the ambitious national poverty reduction target in relation to the expected increased storm intensity at sea by improving the capacity to forecast and adapt offshore oil and gas infrastructure to withstand strong storms and waves.
10. A ninth priority area, underpinning all others, focuses on developing National Institutional Capacity for Climate Change through which overarching programme level coherence will be ensured.

Taken collectively, these activities provide a coherent programme which, if implemented as an integrated programme, would significantly reduce the burden of climate sensitive diseases and risks in Timor-Leste.

The most relevant policies identified from desk review and in consultation with stakeholders are summarized below

Timor-Leste Strategic Development Plan 2011-2030

The Strategic Development Plan builds on the 2002 National Development Plan, and aims to transform Timor-Leste from a low income to an upper middle income country with a healthy, well-educated and safe population by 2030. It outlines specific targets for 2015, 2020, and 2030, including for health and the environment. Environment-related targets include establishing a National Climate Change Centre by 2015 and implementing 70% of NAPA activities by 2020. Sector-specific strategic plans are developed based on the goals and principles outlined in this Plan.

National Health Sector Strategic Plan 2011-2030

Timor-Leste's National Health Sector Strategic Plan (NHSSP) does not address climate change. There is a short section on environmental health that considers sanitation, food safety, vector-borne disease, waste management and air pollution, and outlines objectives for improving the quality of the environment, but the interaction between environmental health and climate change is not included and elaborated. The Plan does not discuss disaster preparedness or management. There is an opportunity to identify and integrate health-related climate impacts and adaptation measures during the Plan's mid-term reviews and four-yearly comprehensive evaluations.

National Nutrition Strategy (2014-2019)

The National Nutrition Strategy 2014-2019 (NNS 2014-19) outlines the approach for translating national commitments on nutrition to actions and results and aligns the nutrition targets and actions towards the National Development Plan 2011-2030. This strategy provides a stronger framework for multisectoral action to address the

immediate, under-lying and basic causes of malnutrition. The vision of the Strategy (TL-NNS) 2014-2019 is to contribute to sustainable achievement of national socio-economic and human development goals by improving quality and productivity of its human capital. The goal of the TL-NNS 2014-2019 is to improve the nutritional status of Timorese population. The purpose of the TL-NNS 2014-2019 is to accelerate reduction of maternal and child under nutrition through implementation of nutrition specific and nutrition sensitive interventions. The overall objective of the strategy is to reduce malnutrition and micronutrient deficiency among children and women

The Strategy provides a framework for directing interventions to improve the nutritional status of all citizens. Its key components are maternal and child nutrition, and food security. It does not address climate change and expected health impacts, nor does it address disaster preparedness and response.

The priorities of the strategy are to:

i) Improve nutrients intake by mothers, children and adolescent girls;
ii) Improve care for mothers and children;
iii) Improve food security at household, community and national levels;
iv) Improve hygiene practices and access to water and sanitation;
v) Promote optimal nutrition behavior and practices;
vi) Improve policies and capacity for multi-sectoral nutrition action

Nutrition specific interventions such as feeding and care practices promotion and protection from illnesses will be implemented predominantly via the health sector. Nutrition sensitive interventions for improving food availability, affordability, access, quality, utilization by families and communities access to Water Sanitation and Hygiene (WASH) interventions will be implemented mainly through non-health sectors i.e. Agriculture, Education, Local Development, Social Solidarity, and WASH related sectors.

National Action Plan for a Hunger and Malnutrition Free Timor-Leste (2014)

The Action Plan's goal is to achieve a hunger and malnutrition-free Timor-Leste by 2025. Of the five pillars, Pillar 3 – that all food systems are sustainable – specifically addresses climate change. Outcome 3.2 is sustainable and climate resilient agriculture, and Outcome 3.3 cross-sectoral policy coherence, encompassing climate change, hazards and disasters. To achieve Outcome 3.2, key activities include strengthening national capacity for disaster risk reduction and management at all levels and strengthening early warning systems for climate change and disasters. The MoH works with other line ministries on these issues under the National Council for Food Security, Sovereignty and Nutrition.

Environmental Health Strategy (2015)

There are nine components within the Environmental Health Strategy – safe water and availability, sanitation and hygiene, food safety, vector control, waste management, healthy working place, safe housing and settlement, air quality, and climate change and health. While many of these components have clear direct and indirect links to climate change, the strategic action points that are documented in this strategy specifically in relation to climate change include the development of national policy and strategy on climate change; the review of policy, strategy, standards and guidelines of all development sectors in respect of climate change and updating these in order for them to be climate resilient; strengthen existing Adaptation Thematic Working Group for climate change and health and intensity meeting for more coordinated action to minimize the health impact of climate change; carry out research to explore the potential impact of climate change on health in various regions of the country, develop alternative technology or ways of living; and take action to protect public health from potential climate change with priority to most vulnerable groups, and develop alternative adaptation mechanisms.

National Disaster Risk Management Policy (2008)

Timor-Leste's disaster policy outlines plans for disaster risk management programs and seeks to integrate disaster management into all sectors. The specific activities outlined in the Policy include identifying risk zones, creating early warning systems, conducting training and capacity building, building up response capacity, and establishing inter-sectoral coordination mechanisms to respond to natural disasters. While the Policy encompasses climate change risks, there is only a brief discussion of health with reference to the preparation of sectoral sub-plans. The health sub-plan is to include risk management of death and morbidity in relation to earthquakes, floods, storms, landslides and epidemics. An updated policy was submitted in 2017 to the Council of Ministers for discussion and approval.

National Adaptation Programme of Action on Climate Change (2010)

Timor-Leste's NAPA briefly considers the vulnerability of key sectors, including health. A number of expected impacts are outlined, but an in-depth vulnerability assessment was not undertaken. Health-related risks are rated as a high priority (priority 3) in the NAPA, and the MoH is tasked with addressing specific vulnerabilities through a proposed US$1.7 million project. The project includes policy reform (review of standards, national health vulnerability assessment), awareness raising and demonstration (integrated climate-related health concerns into suco activities, strengthen early-warning systems, targeted disease prevention measures), and institutional and capacity development (train policy-makers and planners, establish an inter-ministerial mechanism, integrate climate and health linkages into the school curriculum). These activities have not been funded for implementation. The recently approved GEF may support health related activities identified in NAPA.

Initial National Communication to UNFCCC (2014)

Timor-Leste's Initial National Communication to United Nations Framework Conventions on Climate Change (UNFCCC) includes overall vulnerability assessments at the village

level (classifying 44.7% of villages as quite vulnerable, 2.9% as vulnerable and 11.5% as very vulnerable) and sectoral climate change impact assessments. The health assessment lists direct and indirect impacts and assesses the potential impact of climate change (temperature and rainfall) on malaria and dengue by district. Other health-related climate change impacts are not discussed.

Intended Nationally Determined Contribution (INDC) 2016

The republic of Timor-Leste submitted its Intended Nationally Determined Contributions (INDC) towards achieving the objective of the Conventions as set out in its article 2 (Decisions 1/CP19, 1/CP20 and 1/CP21) in a manner that facilitates the clarity, transparency and understanding of the intended nationally determined contribution in October 2016. However, this document has not covered health sector .

Identify additional public health and health-care policies and programmes to prevent likely future health burdens (2.4.2);

Enhancing Ministry of Health and other stakeholders capacity to address health risks of Climate change Government Capacity

The relevant government agencies lack the capacity to effectively adapt to climate change. Stakeholder knowledge assessments show that health professionals and other key stakeholders have low levels of understanding of the risks posed by climate change on water-sensitive diseases48. Understanding of the effects of climate change on other pathways is likely low as well. While a NAPA exist, climate change adaptation is not mainstreamed into regular health programming. There is limited capacity to price and finance adaptation activities, so access to climate finance is relatively low. Hence, there is a need to enhance capacity of Ministry of Health and other stakeholders to mainstream climate change aspects in development plans and programmes as well as to trap international adaptation funds to protect health of people from climate change.

[48]Interim Report of the National Rotavirus Survey(October 2014 – January 2016), Ministerio da Saude, 2016

Enhancing Epidemic Prediction and Response Capabilities

The Ministry of Health has three different departments looking after data collection, data analysis and reporting: the Surveillance Department under the National Directorate of Public Health, the Health Management and Information System (HMIS) Department and the Monitoring and Evaluation Department under the National Directorate of Policy, Planning and Cooperation. Nevertheless these departments are not well integrated in terms of data sharing and number of indicators to be monitored and report for timely decision making. These fragmentations introduced data discrepancies and are also undermined the quality of data used for evidence based planning, monitoring and evaluation. For example, disaggregated data by municipalities is not available for all diseases which inhibit analysis of climatic and health data at municipalities for all climate sensitive diseases.

As described above, there are significant gaps in existing surveillance systems, and the resulting lack of data inhibits epidemic prediction and response. No research has been done to identify the link between weather and disease incidence, and meteorological and disease surveillance data are not consistently shared across departments and ministries. Without data sharing it is not possible to develop the epidemic early warning systems necessary to target outbreak prevention activities.

Capacity building of health professions

The current disease control program in TLS relies on vertical programs particularly for diseases under the GFATM: HIV/AIDS, TB and Malaria. This also applies for other priority disease control programmes which are implemented mainly donor-driven. Therefore, all the climate related diseases are not well coordinated in order to address the overall burden of diseases due to climate change. Healthcare providers and community members have limited knowledge of the prevention, diagnosis, and treatment of climate sensitive diseases. Healthcare providers often do not have access to treatment guidelines for climate sensitive diseases, and households do not have the knowledge or resources to prevent these diseases or to seek treatment when they

become ill. Access to improved water and sanitation facilities, which is protective of many climate-sensitive diseases, is low in rural areas. Where individuals do have access to improved water and sanitation, it is often vulnerable to the floods and droughts that are expected to become more frequent with climate change. Healthcare facilities are vulnerable to extreme weather events and may become inoperable during disasters when their services are urgently needed. Hence, there should be programmes for enhancing capacity of health professionals for timely diagnosis, prevention, control and treatment of climate sensitive diseases and risks.

Strengthening surveillance system

Within the health sector, the surveillance system does not have the capacity to monitor emerging climate sensitive diseases sufficiently accurately. Strengthening of surveillance and early warning systems and more detailed research into historical relationships between health outcomes and climate are now necessary. Case definitions need to be standardized across municiplaitries, and notification data should be geocoded where possible, to facilitate empirical analysis and development of climate-health early warning systems. Case studies of further climate sensitive diseases such as dengue, diarrhea and respiratory illness are suggested.

Identify possible actions to improve health outcomes via adaptation and greenhouse gas mitigation policies and programmes implemented in other sectors (2.4.6).

There should be focused on climate change mitigation and adaption, there is a need of intersectoal collaboration for mitigating greenhouse gases and developing public health adaptation. There are important opportunities for health co benefits of energy and transport policy, including the reduction of air pollution by use of renewable energy rather than burning fossil fuels, and active transportation such as walking, cycling and public transport rather than private motorised vehicles.

Where energy infrastructure is being planned, consideration should be given to use of renewable sources such as solar and hydro-electricty. Road projects should include

physically separated cycle lanes and pedestrian pavements in order to encourage active transport modes. Specials provisions should be made for workers such as working in road projects to protection of their occupational health and safety from dust pollution and heat waves. Adaptation in agriculture should give consideration to potential health effects, via nutritional and energy availability in locally produced foods.

The social protection of livelihoods based on climate sensitive sectors (especially tourism, agriculture) or subsistence lifestyles may increasingly be needed as a result of extreme climate events, fresh water salination, sea water acidification and/or sea level rise. Further collection and analysis of health outcome and climate data at village level is desirable. The analyses presented here are limited by available data and time for analysis.

6 Conclusions and Recommendation

The impact of climate change on the health outcomes of the population in Timor-Leste is complex and manifold. Direct impacts are due to extreme weather events, which are predicted to become more frequent. Indirect impacts on human health result from changes in the hydro-ecological environment, altering infectious disease patterns, and impacting on food and water security.

Despite the inherent degree of uncertainty of climate predictions and the complexity of the impact on health in Timor-Leste, priority adaptation actions can be identified. These actions should strengthen already existing health programs: such as those aiming to reduce morbidity and mortality from extreme weather events, to secure access to safe water, food and improved sanitation, and to enhance vector-borne diseases surveillance and control. Therefore, successful and cost-effective adaption in the health sector is based on including climate change considerations into all main budgeting and strategic health planning processes. Simultaneously these have to be aligned with the overall National Adaptation Plan (NAP) to climate change.

WHO's 'operational framework for building climate resilient health systems' promotes ten essential components, which together form a comprehensive approach to health

adaptation planning. Relating to the six health sector building blocks, these interrelated components can provide a structure for identifying adaptation actions which would mainstream climate change into sector-wide or vertical programs. This present assessment can be used to identify adaptation actions and develop health national adaptation plan (HNAP). As a next step, it will be crucial to include the identified adaptation actions into the national budget planning process, and to mobilize additional funding for those activities that cannot be covered by available financial resources.

Timor-Leste is currently preparing its second communication report to UNFCCC and also strengthening its National Adaption Plan (NAP) process. To this end sectoral Adaptation Plans are required to strengthen this process and increase adaptive capacity of vulnerable sectors. Taking into consideration of future health risks of climate change, HNAP is developed to ensure that the management of health risk of climate change is integrated into the overall NAP process including assessing risks, identifying, prioritizing and implementation of adaptation options. Therefore, development of comprehensive HNAP is recommended as next step. Since the interaction between environment and health is far more intimate and complex than is commonly understood; the HNAP will broaden the linkages between the two and recognize key environmental health issues and bring right interventions. HNAP will also strengthen intra/intersectional approach in understanding and addressing the key environment and climate change key issues including social issues. Since some of the environmental health issues are not within the control of Ministry of Health, program need to collaborate with other relevant agencies and programs having specific mandates to address key public health issues.

Further, the HNAP will help in persuading non-health sectors to consider the public health implications of their policies through stronger collaboration with relevant agencies. Therefore, this HNAP will be a good start in defining the roles and responsibilities of environmental health program within the ministry of health and with partner ministries in including health in their policy, plans and programs to address common concerns in coordinated manner. Finally, HNAP may also provide better opportunity for fund mobilization for health adaptation process

Appendices

Appendix 1: List of participants of inception workshop 5 June 2018

NO	Name	Position	Institute
1	Jose Moniz	Chefe Depart. VSSA	MoH
2	Martinho Fatima	Chefe Depart. NDOC	MSS-DNGRD
3	Augusto Soares	Staff	DNAC
4	Fernando da Silva	Staff	NDMP
5	Simon Done		ILO
6	Evangelita Pereira		World Vision
7	Ana Fatima Soares	Rapid Response Officer	MoH Deprt. Epid.
8	Expedito Belo		UNDP SNC
9	Rodolfo Pereira	WASH Officer	UNICEF
10	Tito de Aquino	PA	WHO
11	Imaculada Belo	Staff	WHO
12	Elizabeth Goncalves	Comm	WHO
13	Eva M.R.F. de J.Magno	Staff	MoH, D
14	Agostinho de Oliveira	WASH Officer	MoH
15	Octavio Pinto	Vector Control	MoH
16	Martinho C. Belo	Sanitation & Igiene Officer	MoH
17	Esperanca Gomes	Asist. Vector Control	MoH
18	Justina Pinto	Food Safety	MoH
19	Francisco Oliveira	Water Safety	MoH
20	Antonio de Limas	Vice Diretor Haburas	MoH
21	Joana Dias	Staf Dep. EIS	MoH
22	Domingas de Castro Cabral	Staff Dep. EIS	MoH
23	Dr. Meghnath Dhimal	Consultant	WHO

Appendix 1: List of participants of validation/finalization workshop 8 June 2018

NO	NARAN	POZISAUN	INSTITUISAUN
1	Jose Moniz	Chefe Depart. VSSA	MoH
2	Martinho Fatima	Chefe Depart. NDOC	MSS-DNGRD
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5	Rodolfo Pereira	WASH Officer	UNICEF
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9	Agostinho de Oliveira	WASH Officer	MoH
10	Octavio Pinto	Vector Control	MoH
11	Martinho C. Belo	Sanitation & Igiene Officer	MoH
12	Esperanca Gomes	Asist. Vector Control	MoH
13	Justina Pinto	Food Safety	MoH
14	Francisco Oliveira	Water Safety	MoH
15	Antonio de Limas	Vice Diretor Haburas	MoH
16	Joana Dias	Staf Dep. EIS	MoH
17	Domingas de Castro Cabral	Staff Dep. EIS	MoH
18	Dr. Meghnath Dhimal	International Consultant	WHO