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Research Article

Climate and Health Vulnerability and Adaptation Assessment at National and Sub-National Levels: Lessons from a Qualitative Study Approach in Timor Leste

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Abstract

Problem: Assessing climate and health related vulnerability and adaptation capacities is a major public health challenge in small island nations and lessons from experience in Timor Leste at both national and subnational levels are of global health interest. **Approach:** The most up-to-date recommended approach by the World Health Organization for assessing climate and health related vulnerability and adaptation capacity is a mix of quantitative and qualitative methods. As a case study, this study undertook data collection at subnational level (all 14 municipalities) including interviews and focus group discussions with the municipality health district directors and the health staff. This paper presents the results of qualitative data analysis. **Results:** The team involved health professionals and experts from national to municipal levels and succeeded in generating valuable results on top hazards (e.g. wind, drought, flooding and landslide) and diseases (e.g. acute infectious respiratory diseases, dengue, diarrhea and malnutrition) in each municipality as well as recommendations including some specific ones for the respective zones. **Lessons learnt:** Quantitative approaches are challenging in low-and-middle income countries in general and in small island nations in particular, where the health information system is weak. Putting health staff and community views at the center of the qualitative approach in the assessment process and ensuring a collaboration between health professionals (at national and municipal levels) and academic researchers in the field were key in generating valuable results that can support decision makers to shape the solutions to local contexts.

Introduction

The Intergovernmental Panel of Experts on Climate Change (IPCC) stated in its Sixth Assessment Report that climate change impacts and risks are amplified for small island nations and territories, compared to other landmasses (Mycoo et al. 2022). This is because they are surrounded by oceans and have comparatively small land areas. It is estimated that 50% of the Pacific's population lives within 10 km of the coast along with >50% of their infrastructure concentrated within 500 m of the coast (Mycoo et al., 2022). These specificities increase the exposure and vulnerability of small islands natural and human systems to climate change extreme events. In the domain of climate change and health, even if all populations on all continents are at risk, some places and groups are most exposed and vulnerable. Small island developing states (SIDS) are among hotspots for major climate-related hazards and high burdens of some climate sensitive diseases.

The health impacts of climate change can be direct or indirect, affecting both communicable and non-communicable diseases, and include disruptions to the wellbeing of people (Cissé et al., 2022). To decide on the most appropriate measures, countries need to get comprehensive knowledge about where the most exposed and vulnerable zones and people are. It is very important for any country to regularly undertake an evaluation of the vulnerability and adaptation (V&A) of its health systems. For undertaking assessment studies there is a need to get access to data and to use relevant frameworks and tools (Pradyumna & Sankam, 2022). The availability and the quality of data, as well as of methodologies easy to implement in a way that produces relevant knowledge for public health action, are challenging in Low- and Middle-Income Countries (LMIC) in general and in SIDS in particular.

Timor-Leste is a small island nation located in Southeast Asia on the southernmost edge of the Indonesian archipelago, northwest of Australia, and among the most concerned small islands par climate change impacts. The World Health Organization and the Ministry of Health of Timor Leste launched a study that used the WHO frameworks to undertake a V&A assessment in Timor Leste with the ambition to cover the national and sub-national levels. The availability of quality health data over a long period was an anticipated limitation as there are several challenges associated with the use of data from the routine health information systems in the low- and middle-income countries (Hoxha-et-al., 2020). Collecting historical data for health at the municipality level has been challenging and often not at the periodicity required to match climate data e.g. at least weekly. For example, the records of health data were available at the national level for 2022 and 2023 only. A recent systematic review (Kim et al., 2022) has highlighted that the literature's geographical scope on health impacts of climate change in SIDS is skewed due to many reasons.

Therefore, a qualitative approach was crucial to compensate for the weakness on data side, took an important place in the study conduct and gathered relevant results for policy makers. A qualitative method is useful when access to quantitative data is limited, while local health staff could have valuable insights into the problems. The study team adapted the WHO guidelines to the local contexts and implemented a mixed approach that allows for getting some timely, helpful results for public health action, rather than waiting for the right quality and quantity of data to do "a gold standard study".

This paper presents the results from the use of the WHO frameworks with an emphasis on qualitative approaches including at community level.

Approach, Material and Methods

Context

Timor Leste is a country with an area of 14,874 km2 and became an independent nation in 2002. Hills and mountains mark the country's topography. The 2022 Population and Housing Census (National Institute of Statistics, 2023) detail the following demographic features: a resident population of 1,340,434 persons in 250,034 households; 678,087 males (50.60%), and 662,347 females (49.40%) and 32.1% living in urban areas; and an average annual population growth rate of 1.8%. The Census projected that the population would increase to 1,495,000 by 2030, of whom 35.2% will be urban. The capital and largest city is Dili; the second largest city is the eastern town of Baucau, and these two urban centres are home to 34.20% of the population. Most of the population is rural, with most people living in small and scattered villages. The country's administrative structure is composed of 14 Municipalities (one of which is also a Special Administrative Region (Dili), 452 Sucos (villages) and 2,336 Aldeios (hamlets).

The country's nominal (current) Gross Domestic Product (GDP) is $2,079,916,900 (USD) as of 2023 (Worldmeters, 2025). Real GDP (constant, inflation adjusted) of Timor-Leste reached $1,769,696,989 in 2023. The GDP per Capita in Timor-Leste (with a population of 1,384,286 people) was $1,278 in 2023, showing a decrease of $300 from $1,578 in 2022; this represents a change of −19% in GDP per capita. More than 40.8% of the population lives under the poverty line with less than USD 0.55 per day. The health funding amounted to 3.92% GDP in 2017 (US$115.8 million) and increased to 7% in 2019. In 2019, the health funding was mainly done by government (60%), external (22.4%), out of pocket (<10%) and voluntary health insurance (<3%).

In all adults, infectious diseases are in the top 10 causes of death, and many of the major causes of death are climate sensitive illnesses (WHO, 2025). There has been an average temperature rise since

1986 in Timor Leste with a rate of about 0.016°C per year and will be increased up to 1ºC in 2040, and 3ºC in 2100 (State Secretariat for Environment, 2014). This is likely to increase the intensity of, although lower the numbers of tropical cyclones, increase rainfall, increase inundation and in many areas increase landslides, flooding, and droughts. Estimates of sea level rise of 0.08 to 0.18 meters by 2030 under RCP 8.5 (CSIRO & SPREP, 2021). In the last two decades, the country has experienced an increase in the frequency and intensity of extreme climate events (tropical windstorms, droughts, flash floods, inland and coastal floods, and landslides) that have mostly affected vulnerable rural communities, including heavily affecting their health and wellbeing. Climate change is a major threat to public health in Timor Leste that needs undertaking a vulnerability and adaptation assessment.

Timor-Leste is engaged in the Male' Declaration and Regional Framework of Action for building health systems resilience to climate change, endorsed by the Ministries of Health of the World Health Organization South-East Asia Region (WHO SEAR). There is a WHO Special Initiative on Climate Change and Health in Small Island Developing States (SIDS) in the African and South-East Asian Regions of the World Health Organization that includes a Regional Plan of Action (2018-2023). This plan includes two countries of the WHO SEAR: the Maldives and Timor-Leste. The TL health sector has endorsed a Climate Resilient and Environmentally Sustainable Health Care Facilities Policy and Strategy (CRESH) and a Health National Adaptation Plan (MOH 2024).

It is in such local settings that a climate and health V&A and Climate and Health Risk Profile development for all municipalities has been undertaken at national and subnational levels. The aim of the vulnerability and adaptation assessment (V&A) and Climate and Health Risk Profile development for all municipalities for Timor Leste is to get a better understanding, at both national and subnational levels, of the current and future vulnerability to the health risks of climate variability and change. This required a combination of efforts between experts from WHO, the Ministry of Health and universities. This will provide decision-makers with needed information for initiating and implementing relevant measures, policies, and programs. These measures include reinforcing capacities of health systems and communities that could increase resilience at both national and subnational levels, particularly in high priority areas.

Methodological framework

The World Health Organization (WHO) has issued important guiding documents for evaluating health related vulnerabilities and adaptation capacities and for setting-up the consequent health national adaptation plan. The main ones are the Operational Framework for Building Climate-resilient Health Systems (WHO, 2015), the Guidance for climate-resilient and environmentally sustainable health care facilities (WHO, 2020) and the Vulnerability and Adaptation Framework (WHO, 2021).

Data collection

The V&A assessment in Timor Leste included national and municipality levels investigation. The study team in the field was composed of interviewers from the university (professors and students), the Ministry of Health (environmental health national and municipal professionals), the WHO office and the contact person at the visited municipality. The tools were translated into Tetun; the focus group discussions and the individual interviews were conducted in Tetun or local languages. The local professionals worked with experts from James Cook University in Australia.

The field visits were conducted in all 14 municipalities over two weeks in late 2023 to ensure municipality specific data was collected and collated for data consistency and accuracy. The objectives of the field visits were to observe the specific climate related hazards realities, discuss with the local health authorities and staff about the climate change and health challenges, and solutions they proposed as most appropriate to their local contexts. The average two days agenda in each municipality included visiting health facilities, most vulnerable zones to extreme climate events, local authorities, communities and other relevant places and persons identified in consultation with the WHO Office, there was no collection of human biological samples of any kind nor any samples from the environment (water, soil, air). The field visit was preceded by an inception workshop in Dili, the capital city (November 2023); analysis and recommendations were completed by a final workshop organised in Dili (June 2024).

In each municipality, the main activities of the study team included:

- Structured in-depth interviews with: (i) the Director of the Municipality Health Services (DMHS); and (ii) an opportunistic sample of representatives of vulnerable groups (defined as children, women, older persons, pregnant and breastfeeding women, chronically ill or people with a disability) (n=49) with three open-ended questions about their concerns regarding climate change related hazards and potential impacts on health in the community or themselves; what concrete experiences they have had; and what solutions do they wish to see to better protect the lives and the health of the community.
- Observations of health facilities recently affected by climate hazards or exposed to such potential hazards and other most vulnerable places in the city (e.g., schools, underprivileged areas, to review facility water and power supply, building construction, location, and accessibility).

- Focus Group Discussions allowing an exploration of potential most urgent climate-related actions by the health sector and other important sectors were held with a sample of 6-12 health staff and were open-ended. Then the participants were asked to develop "sensitivity matrixes" related to hazards and diseases in their municipality (listing and ranking hazards and diseases between 1 (minor) to 5 (major) across sub-districts in each municipality). At the national level, a FGD and group discussion at the inception workshop developed similar data and matrices.

Data analyses

Analysis was undertaken using deductive coding of all three data sets, against a coding key developed based on the WHO health related vulnerabilities and adaptation capacities documents (WHO, 2015; WHO, 2020; WHO, 2021) by at least two coders and reviewed by at least one of the JCU team. The medical terms used are based on those used by the participants.

Results

Climate related hazards

From the FGDs at municipality level, it appears that drought and dry season are the top hazards identified by participants as affecting nine municipalities, followed by flood and heavy rains affecting eight, and wind affecting seven. Heat was identified as a top issue in five municipalities (Atauro, Bobonaro, Dili, Liquica and Viqueque) and landslides were in four municipalities (Aileu, Ainaro, Covalima and Viqueque). The participants in Viqueque identified that they were affected by five major hazards and those in Aileu and Bobonaro listed three top hazards (Table 1).

Num	Municipality	Top hazards in the Municipality (From health staff perception)	Top diseases in the Municipality (From Health staff perception)
		Top hazards	**Top diseases**
1	**Aileu**	**Wind** (rated 5 in all 4 subdistricts), **Landslide** (rated 5 in Remexio), **Heavy rain** (rated 4 in all subdistricts) and **Fire** (rated 5 in 2 subdistricts)	**ARI** (rate 5 in all subdistricts), **diarrhoea** (rate of 4 in all subdistricts)
2	**Ainaro**	**Landslides** and **dry season** (with rate 5 in all 4 subdistricts) and **strong winds** (rate 5 in 3 subdistricts and rate 3 in 1 subdistrict)	**ARI**, scabies, acute **diarrhoea** and asthma (each at rate 5), pneumonia and **dengue** (rate 4)
3	**Atauro**	**Rough seas** and **drought** (rate 5 in all 5 subdistricts), **heat** (rate 5 in 4 subdistricts).	**ARI** (rate 5 in all subdistricts), TB (rate 5 in 3 subdistricts). Four diseases (skin diseases, hypertension, **dengue** and mental health) come together in the third position (rated 5 in 3 municipalities)
4	**Baucau**	**Flooding** and **drought** (rate 5 in all 6 subdistricts), h**eavy rain (r**ate 5 in 5 subdistricts).	**ARI** (rate 5 in all subdistricts), **dermatitis** and **dengue** (dengue at rate 5 in 1 subdistrict).
5	**Bobonaro**	**Strong winds** (rate 5 in all 6 districts), **drought** and **heat** (rate 5 in 4 subdistricts)	**ARI, injury** (rate 5 in 3 subdistricts on 6), **diarrhoea** and skin diseases (rate 5 in 2 subdistricts), **malnutrition** (rate 4 in all subdistricts)
6	**Covalima**	**Drought** (rate 5 in all 7 subdisricts), **landslide** (rate 5 in 2 subdistricts and rate 4 in other subdistricts).	**ARI, acute diarrhoea** and **asthma** (rate 5)
7	**Dili**	**Drought**, **heat** and **heavy rain** (rate 5 in all 5 subdistricts).	**Stress** (rate 5 in all subdistricts), **ARI** (rate 5 in 4 subdistricts) and **malnutrition** (rate 5 in 3 subdistricts).
8	**Ermera**	**Drought** and **wind** (rate 5 in all 6 subdistricts), **heavy rain** (rate 5 in 5 subdistricts)	**ARI**, **acute diarrhoea**, scabies, pneumonia, TB, **malnutrition** and **dengue** (rate 5)

9	**Lautem**	**Drought** and **strong winds** (rate 5 in all 6 municipalities)	**ARI** and **acute diarrhoea** (rate 5)
10	**Liquica**	**Heat** (rated 5 in all 3 subdistricts); **flooding, landslide** and **drought** (rate 4 in 4 subdistricts)	**ARI** (rate 5 in all 3 subdistricts), skin infection (rate 4 in all subdistricts), and **dengue** (rate 4 in 1 and rate 3 in 2
11	**Manatuto**	**Flooding, wind** and **fire** (rate 5 in all 6 municipalities)	**ARI** (rate 5 in 2 subdistricts, rate 4 in 4), T**B** (rate 4 in all subdistricts) and **diarrhoea** (rate 4 in 3 and rate 3 in 3)
12	**Manufahi**	**Wind** and **flooding** (rate 5 for 3 subdistricts on 4)	**ARI**, **diarrhoea** and **hypertension** (rate 5 in all subdistricts), **mental health** (rate 5 in 2 subdistricts), skin infection and **dengue** (rate 5 in 1 subdistrict).
13	**Oecusse**	**Heavy rain** and **fire** (rate 5 in all 4 subdistricts), **heat** (rate 4 in all 4 subdistricts), **flooding** (rate 5 in 2 subdistricts), **landslide** and **drought**.	**ARI** (rate 5 in all subdistricts), **skin disease** and **diarrhoea**
14	**Viqueque**	**Heat** (rated 5 in all 5 subdistricts); **drought** (rate 5 in 3 subdistricts), **flooding** (rate 5 in 4 districts), **wind** and landslide (rate 5 in 3 subdistricts).	**ARI**, **acute diarrhoea** and **dengue**

Table 1: Importance of hazards and diseases by sub-district from the health staff's perceptions at municipality level in Timor Leste (**Source:** focus group discussion in municipalities, November 2023) (5 means top consequence, down to 1 meaning minor issue).

The vulnerable people interviewed had a broad range of climate linked effects that they discussed, and many of them have recently experienced. Almost universally across the country, they discussed floods, heavy rain, heatwaves, landslides, heavy winds and drought. Some people living on coasts raised concerns of sea level rise and high waves. One older woman living in the mountains described cold as an issue for her, and two people discussed fire as an issue.

Climate related health issues

At the municipality level, sensitivity matrices with health staff revealed that Acute respiratory tract infections (ARI) were perceived by all participants as one of the top health hazards except in two municipalities (Table 1). Malnutrition was mentioned by Ermera and Ainaro, and Manufahi also mentioned diarrhoea and hypertension. Interestingly, participants in Dili were the only ones to mention stress and this was the only health problem that they prioritized. Bobonaro also listed injury as the top issue and was the only municipality to do so. (Table 1).

From the FGD and group discussions at the national level, the sensitivity matrices show that national health staff and managers felt that the most common health problems having a link to climate change were upper respiratory tract infections, dengue, diarrhoeal diseases, skin diseases, eye diseases, malnutrition, fever, food insecurity and stress. The two top common health problems identified by national level participants as occurring in all municipalities are ARI and Acute diarrhoea (65). Participants ranked asthma (55) with score 5 in 8 municipalities and the next highest total score; then come dengue (53) and pneumonia (51). In the lower scoring conditions variation was noted between municipalities e.g. malnutrition (score 5 in 4 municipalities), scabies (score 5 in 5 municipalities) and TB (score 5 in 3 municipalities). The national participants identified the top three affected municipalities as Dili, Ermera and Ainaro (Figure 1).

Health Problem	Aileu	Ainaro	Baucau	Bobo-naro	Cova-lima	Dili	Ermera	Lau-tem	Liquica	Mana-tuto	Manu-fahi	Oe-cusse	Vique-que	*Total*
Scabies	5	5	1	4	2	2	5	3	5	1	4	5	3	***45***
ARI	5	5	5	5	5	5	5	5	5	5	5	5	5	***65***
Pneumonia	4	4	3	4	4	5	5	4	4	3	4	4	3	***51***
Acute Diarrhoea	5	5	5	5	5	5	5	5	5	5	5	5	5	***65***
Diarrhoea with blood	3	3	4	3	4	5	2	2	2	2	2	3	2	***37***
Dengue	4	4	4	4	4	5	5	4	3	5	4	2	5	***53***
TB	2	3	4	4	3	5	5	2	4	2	3	5	3	***47***
Traffic Accident	3	5	5	4	4	5	4	2	4	3	3	2	4	***48***
Malnutrition	3	3	4	3	4	5	5	3	2	2	5	5	3	***46***
Asthma	5	5	5	5	5	5	4	3	2	2	5	5	4	***55***
Total	***39***	***42***	***40***	***41***	***40***	***47***	***45***	***33***	***36***	***30***	***40***	***41***	***37***	

Legend: Importance of the disease is rated between 5 (highest)(red) and 1 (lowest) light blue).

Figure 1: Importance of diseases by municipality from the stakeholders' perceptions at national level in Timor Leste (**Source:** Inception workshop, November 2023) (5 means top consequence, down to 1 meaning minor issue).

Based on the in-depth interviews with vulnerable persons across 13 of the 14 municipalities (not done in Dili), they identified diarrhea and respiratory issues (ARI, shortness of breath, cough, nasal congestion) as their major concerns linked to climate. Vector-borne disease (dengue) and skin issues/scabies were the second most mentioned, as were concerns regarding food insecurity (often attributed by them to the effects of climate on animal and plant health, causing this situation). Psychological and mental health issues such as stress, mood changes, "poor sleep" were another common category of concerns. A range of other concerns were listed infrequently, such as pain, malnutrition, fever, headache and trauma. There were no gender or age group differences noted in responses.

Suggested Solutions to Address Climate Change and Health in the Country

The discussions with the principal actors of the municipality health system identified several priority measures for health system adaptation to climate change at the subnational level. These included: (i) strengthening of knowledge of municipal and sub-municipal health staff on climate hazards, climate change and health effects; (ii) that community health workers, allied health professionals, health managers, doctors and nurses need to have their capacity built to understand the importance of and how to integrate climate-related health risks into their work; (iii) investing in infrastructure to make health facilities more resilient including renewable

energy, safe and secure water supplies, physical accessibility of existing health facilities and waste management; (iv) allocating budget at subnational levels to increase preparedness and response to extreme weather events at health care facility level; (v) improving community knowledge linked to climate change and health, and behaviours linked to resilience.

Perspectives of the Community Members

Vulnerable people had similar recommendations regarding improving health facilities accessibility, power, water supply; improved early warning systems and response from the health sector; and wanted more social and behavioural change communication about the risks and ways to prevent or mitigate the climate linked health impacts. However, they had a broad range of concerns for their communities regarding drought-proof water supplies. Improved road and bridge infrastructure, more flood control/mitigation measures, and improved drainage, sewage and waste management systems overall. They discussed a desire for government authorities to assist people in assessing where best to build their homes and good construction techniques to future proof them, and to encourage people to grow, not cut down trees. Many vulnerable people discussed the need for more social protection and relief for survivors of climate disasters, and many described the need to improve food security to be climate proof.

Discussion

Limitations

This study was undertaken within a global V&A study submitted to a very tight agenda (visiting all the 14 municipalities within one month, with 2 days of data collection in each municipality). Due to agendas matters and some constraints locally, the focus group discussions with health staff could not be organized in three municipalities on 14. The suggestion for future studies like this one is to ensure more time for good preparation and taking more time at each place. Nevertheless, the study was an extraordinary eye opener for the health staff and the staff gathered in focus group discussions expressed their appreciation of their first-time invitation to discuss this important topic of climate change and health. They indicated having learned a lot on the matter and wished to get more training in the future.

Interpretation of the Results

The qualitative approach within the climate and health vulnerability and adaptation assessment in a small island nation and especially assessing at subnational levels has been useful to complement the limited availability of quantitative data. Valuable in-depth insights on the issues experienced locally from the health staff and communities can assist in informing prioritizing local level actions. Implementing a mixed approach provided relevant and coherent results on top hazards (e.g. wind, drought, flooding and landslide) and top health concerns (e.g. acute infectious respiratory diseases, dengue, diarrhea and malnutrition) in each municipality.

Implication and Significance of the Results

These results are already helpful for public health action showing that waiting for perfect quantitative data for a gold standard assessment is not necessary and may cause major delays in adaptation and development of resilient and low carbon health systems. The qualitative approach has shown its valuable complementarity to the quantitative methods of the WHO frameworks and played a first important role as an eye-opener on the reality of the issues and experiences for the principal actors in the public health arena at national and subnational level.

Conclusion

The qualitative data of this Vulnerability and Adaptation assessment in Timor Leste has generated interesting results to support the development of recommendations towards a prioritized and effective health related climate action. Interviews with the Directors of the Municipal Health Services and community members, and a focus group discussion with the health staff in each municipality, provided grounded and lived experiences of climate hazards and health to the principal actors in the national public health arena.

The qualitative tools clearly identified the main hazards and health conditions in each municipality and as well as local contextual differences (e.g. coastal areas, mountain areas, urban areas) to support local level planning and action. The climate-health adaptation strategies mentioned include targeted training for health workers, resilient infrastructure and tailored communication for marginalized groups. The qualitative approach used and the results from Timor Leste are of high importance for other small island nations.

More efforts are needed to get reliable past records of quantitative data on health and climate that will allow robust statistical analyses and projections. This study has shown that in parallel a qualitative approach can generate results that are enough for undertaking the most urgent climate and health action in most vulnerable areas and for most vulnerable people.

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Ethical Considerations

The Timor Leste V&A study protocol received the ethical approval from the Unidade Ética Pesquize E Dezemvolvimento do Instituto Nacional de Saúde Pública de Timor Leste (Ref 44/INSP-UEPD/X/2023, 13 October 2023), James Cook University (HREC #9278, 23 October 2023) and WHO SEARO Ethics Review Committee (ID: 2023.30.NW, 16.11.2023).

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