Advancing climate change monitoring in the Pacific Islands Countries and Territories through household surveys

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Abstract

Climate change is one of the biggest threats facing humanity, undermining the development progress in health and poverty reduction made over the past 50 years. Vulnerability to climate change is more critical in locations experiencing poverty, governance challenges, limited access to essential services and resources, conflicts and high levels of climate-sensitive livelihoods. The economic sectors more likely to be climate-exposed are agriculture, forestry and fisheries in hotspots of high human vulnerability including Small Island Developing States (SIDS) (IPCC,2022).

Pacific Island Counties and Territories (PICTs) are characterised among those countries most severely impacted by climate change (Nurse et al., 2014), primarily because of their disproportionately high exposure to both slow-onset and extreme hydrometeorological events combined with the limitations of their economic and natural resources for mitigating such risks (Robinson 2015). To address the challenges of climate change, PICT governments have developed and improved local, national, and international policies that accelerate greenhouse gas mitigation, increase climate adaptation, mobilise new financial resources, and create climate-resilient societies.

While substantive knowledge and case studies have been accumulated on the linkages of climate change to economic sectors, society, economics and the environment of local communities, PICTs do not have a standard methodology to regularly collect data that present an overall socio-economic picture on the impact of climate change on households. The inclusion of socio-economic dimensions and determinants of climate change impacts on households in household surveys is essential to derive appropriate measures of mitigation and adaptation and effective public investments. This paper presents a Core Module and an expanded version (Sourcebook) of a Climate Change and Natural

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Disasters Survey Module for household surveys developed by the Statistics for Development Division of the Pacific Community (SPC).

The survey module aims to capture climate change vulnerabilities, impacts and responses at the household level. It is based on the reporting modalities established and agreed upon under the Paris Agreement Work Programme (PAWP) and the four complimentary international frameworks endorsed to link PAWP reporting requirements: the Framework for the Development of Environment Statistics (FDES, 2013), the Sendai Framework for Disaster Risk Reduction (Sendai Framework, 2015), the Disaster-related Statistics Framework (DRSF, 2018) and more recently, the Global Set of Climate Change Statistics (Global Set, 2022).

The Climate Change and Natural Disasters Survey Module was developed to be systematically included in future PICT population-based censuses and household surveys and aims for coherence with, and integration into, national statistical systems, regional and global monitoring frameworks.

Keywords: Climate change statistics; Pacific Islands; household level impacts

1. Introduction

Monitoring national level natural disasters and climate action plans in the Pacific depends on high-quality data. Comparable data is needed to understand awareness and experiences of natural disasters, climate change-induced impacts, and adaptive measures taken by households over time and between countries to compare regional and global trends. Climate change and natural disasters statistics enable comprehensive assessment of socio-economics effects and a strengthening of evidence-informed policymaking at all levels for Disaster Risk Reduction (DRR) and climate change adaptation.

Despite its significance, it is rare for PICTs to produce and maintain reliable statistics on the socio-economic impacts of climate change and natural disasters. They are aggregated into the poverty or sectorial statistics (e.g., agriculture) or not counted at all, leading to an under-representation of the impacts and marginalisation of households most affected by climate change and natural disasters.

A review of existing population and agriculture censuses questionnaires and household survey methodologies revealed minimal efforts to monitor climate change and natural disaster impacts and response, except for recent population and agricultural censuses conducted in countries heavily impacted by natural disasters, such as Kiribati, Nauru, Tanzania, Belize and Benin. Moreover, only Nepal and Bangladesh conduct national household surveys on climate change, which aim to characterise populations in natural disaster-prone areas, assess climate change's impacts on economic activities (mainly agriculture), assets, health, and vulnerability and describe climate change perceptions and adaptation measures (SPC, 2023).

This paper explores a pragmatic procedure to improve PICT's national capacity to monitor climate change and natural disaster impacts and response at the household level. The proposed survey module will measure the adverse effects of climate change on humans (such as injuries, disabilities, diseases, missing persons and deaths); households' assets, (infrastructure, equipment and agricultural land); food production, fish biomass and agriculture, both crops and livestock; freshwater availability;

households' livelihoods, income, employment; health risks; lack of access to social services and forced displacements, in some cases.

In addition to the measurement of natural disasters and climate change impacts on households' livelihoods, food security, productive assets and health, the module proposes the monitoring of novel and, in turn, critical aspects: climate change perceptions, vulnerability, gender aspects, environmental degradation and adaptation strategies.

While recognising the general difficulty of investing resources to monitor climate change and natural disaster impacts and response, this proposal emphasises the effective use of existing statistical instruments rather than developing new instruments.

2. Overall concept of the Natural Disasters and Climate Change Survey Module

The primary demand for natural disasters and climate change statistics is to analyse trends and characteristics in the occurrence of hazardous events. The Survey Module proposed will not collect scientific or meteorological data describing changes in weather and events since they are already covered by monitoring systems at local and international levels. Instead, the primary motivation for developing the Core Module and Sourcebook and promoting their implementation in National Statistical Systems (NSS), is to encourage the production and use of socio-economic information on the household impacts of natural disasters and climate change in the PICTs.

The Survey Module comprises the Core Module and the accompanying Sourcebook. The Core Module's general objective is to gather nationally relevant and internationally comparable socio-economic data over time, through a short set of fixed questions to be regularly included in existing household surveys and censuses. The Sourcebook aims to provide guidance to PICTs in generating comprehensive statistics beyond the socio-economic impacts of natural disasters, covering multiple other dimensions. It will review the actual situation and potential, identify gaps or duplication, and progress a development and implementation plan to produce detailed information on Natural Disasters and Climate Change impacts and responses at national level.

The Core Module and Sourcebook were guided by the Global Set of Climate Change Statistics and Indicators (UNSD, 2022), which provides a comprehensive statistical framework with statistics, indicators and metadata designed to support countries in preparing their own sets of climate change statistics according to their own concerns, priorities and resources. In addition, the 2030 Agenda, the FDES 2013, the Sendai Framework 2015, and the DRSF 2018 were also consulted

The Core Module will generate a set of data to evaluate natural disaster impacts at the household level. It comprises eleven questions that could be included regularly in typical data collection mechanisms already administered by National Statistics Offices.

It emphasises the climatic-related natural disasters impacting the household in the past 12 months and their socio-economic effects. In the template questionnaire, the first question investigates whether hazards (e.g., floods, droughts, storms, landslides, extreme temperatures and wildfires) impacted the household. Subsequent questions examine damages and their economic impacts. For example, question two concerns the type of damage affecting the household. Questions three, four and five study the economic value of damages in the household dwelling and its productive assets. The following questions investigate human health aspects impacted by natural disasters: question six looks at the number of people injured and question seven persons who got sick because of the

hazard. Questions eight and nine explore the working days household members lost and the school days children lost as a cause of the natural disaster. The final two questions examine disruption to essential services used by households and people's displacement due to natural disasters.

Nine national indicators can be derived from the Core Module described above. These indicators can contribute to the monitoring of global frameworks, including the 2030 Agenda (SDGs), the Global Set of Climate Change indicators (GS), the SENDAI framework and the FDES (see Table 1).

Table 1. Indicators derived from the Core Module on Natural Disasters and Climate Change

INDICATOR	Correspondence to Global Set on Climate Change, SDGs, SENDAI Framework and FDES indicators
Distribution of households according to the type of natural disaster that last affected them	GS #39 Frequency of hazardous events and disasters Sendai B-1: (Compound) Number of directly affected people attributed to disasters, per 100,000 population.
Percentage of households with dwellings damaged, by natural disaster category	GS #41 Direct economic loss in the housing sector attributed to disasters Sendai B-3: Number of people whose damaged dwellings were attributed to disasters. Sendai B-4: Number of people whose destroyed dwellings were attributed to disasters. Sendai C-4: Direct economic loss in the housing sector attributed to disasters
Percentage of households with productive assets damaged, by natural disaster category	GS #40 Direct economic loss to all other damaged or destroyed productive assets attributed to disasters SDG 1.5.2 - Direct economic loss attributed to disasters in relation to global gross domestic product SDG 11.5.2: Disaster losses related to GDP.
Number of persons sick or injured, by natural disaster category	GS #44 Incidence of cases of climate-related diseases Sendai B-2: Number of injured or ill people attributed to disasters, per 100,000 population.
Economic value of damages on dwellings, by natural disaster category	GS #41 Direct economic loss in the housing sector attributed to disasters SDG 1.5.2; SDG 11.5.2 FDES 4.1.2.b Economic losses due to natural extreme events and disasters Sendai C-3: Direct economic loss to all other damaged or destroyed productive assets attributed to disasters.
Economic value of damages on productive assets, by natural disaster category	GS #40 Direct economic loss to all other damaged or destroyed productive assets attributed to disasters SDG 1.5.2; SDG 11.5.2 Sendai B-5: Number of people whose livelihoods were disrupted or destroyed, attributed to disasters.
Percentage of households that suffered from basic services disruption due to natural disasters	GS #75 Direct economic loss in the housing sector attributed to disasters GS #77 Impacts of climate change on transport Sendai D-1 (compound): Damage to critical infrastructure attributed to disasters.

INDICATOR	Correspondence to Global Set on Climate Change, SDGs, SENDAI Framework and FDES indicators
Distribution of households according to the type of basic service disrupted due to natural disasters	GS #75 Direct economic loss in the housing sector attributed to disasters GS #77 Impacts of climate change on transport Sendai D-1 (compound): Damage to critical infrastructure attributed to disasters
No. of persons forced to displace because of the natural disaster	GS #43 Number of climate refugees, climate migrants and persons displaced by climate change

The Core Module implementation can be aligned with meteorological measurements and monitoring systems to match results to known natural events. Additionally, administrative data from the registrations of Health, Labour and Education Ministries and records from NGOs and civil society in the aftermath of a hazard event can be another important source in the data analysis. Field surveys, case studies and dedicated ad-hoc surveys run during or after a natural disaster can provide additional opportunities to obtain detailed information on a specific event.

3. The Sourcebook on Climate Change and Natural Disasters

The Sourcebook will guide the collection of the impact and response to climate change at the household level, considering multiple dimensions:

- Characteristics of populations at risk of being affected by climate change and natural disasters
- Perceptions of climate change
- Impacts of natural disasters and slow-onset climate change events (SOE)
- Natural disasters prevention/response and adaptation
- Gender and displacement

These dimensions will enable a comprehensive assessment of socio-economic impacts and household responses to natural disasters and climate change on any magnitude of these events.

Below is a brief description of the climate change and natural disasters characteristics in the PICT populations that motivated the consideration of the listed dimensions in the sourcebook:

- approximately one-in-four people live below the poverty line (24 per cent, corresponding to the median poverty rate across PICTs) with unique challenges in addressing their poverty condition (WB, 2016). People with low livelihoods are more vulnerable and less resilient to shocks like natural disasters.
- most development and settlement in atoll islands occur close to the coast, with 55 per cent of the Pacific's population (excluding Papua New Guinea) living less than 1 km from the sea (WB, 2016 and SPC, 2023), increasing exposure and vulnerability to natural disasters such as storms and sea level rise.
- agriculture is fundamental to the livelihoods of most people. The populations have a dual economy consisting of a small cash economy and a subsistence economy focused on traditional fishing and small-scale agriculture (WB, 2016). Tourism is a growing economic sector in the PICTs, providing the region with immense potential for economic development.
- freshwater supply is limited due to the decrease in rainfall, limited rainwater storage capacity, the salination of the groundwater lens and an increase in demand (e.g., population growth and tourism). These countries are already water-scarce with low groundwater volumes.

Risk exposure information is fundamental to the construction of baseline statistics and for assessing impacts after a climatic-related disaster or SOE. The number of people, demographic changes, housing (construction materials, ownership, etc.), buildings (or built-up areas), critical infrastructure (such as transportation or water facilities, etc.), type of employment, income, land use, production capacities (land use, crop areas, assets), and high nature value ecosystems are necessary variables to assess households' risk exposure. These are prioritised in the Sourcebook.

Determining the factors or processes that increase households' vulnerability (individuals and communities) to natural disasters and climate change is also important. For example, person's age, disabilities or lack of individual skills can heighten an individual's vulnerability, as can less healthy or unsafe environments and poor education. Poor access to fresh water or adequate sanitation facilities and lack of access to other essential services (such as health facilities, roads, markets) can undermine resilience capacity since these services are needed to recover from a natural disaster.

Table 2 shows preliminary indicators to be derived from the template questions proposed in the Sourcebook´s Household Roster and Housing sections:

Table 2. Indicators derived from Sourcebook´s Household Roster and Housing sections

INDICATOR CATEGORY	Correspondence to the Global Set of Climate Change Statistics and indicators, SDGs or SENDAI Framework indicators
Socio-demographic	
Distribution of household members by sex, age	-
Percentage of female-headed households	-
Average age of female-headed household	-
Average household size	-
Percentage of households' income dependent on primary activities (family farming, crops, fishing, etc.).	FGS #86 Population relying on subsistence and pastoral farming
Percentage of households' income dependent on non-primary activities (e.g., tourism).	-
Distribution of households by income level	FGS #101 Proportion of the population living below the international poverty line by sex, age, employment status and geographic location (urban/rural) SDG 1.1.1 Proportion of population below the international poverty line
Distribution of households by assets value	-
Percentage of farming households owning agricultural land	-
Percentage of farming households renting agricultural land	-
Housing	
Distribution of household by ownership status of the dwelling	-
Percentage of dwellings not prepared to resist to natural disasters/ Percentage of dwellings prepared to resist to natural disasters	FGS #91 Infrastructure vulnerable to climate change

INDICATOR CATEGORY	Correspondence to the Global Set of Climate Change Statistics and indicators, SDGs or SENDAI Framework indicators
	FGS #92 Buildings (settlements) vulnerable to climate change FDES 5.1.3.d Hazard prone areas
Percentage of households not connected to the electricity grid	FGS #95 Proportion of population with access to electricity SDG 7.1.1 Population with access to electricity
Percentage of households connected to internet	SDG 17.8.1 Proportion of individuals using the Internet
Percentage of household members with access to a mobile telephone	SDG5.b.1 Proportion of individuals who own a mobile telephone, by sex
Percentage households having pipe borne water/ Percentage households not having pipe borne water	FGS #98 Proportion of population using safely managed drinking water services SDG 6.1.1 Population using safely managed drinking water services
Average number of days per month without sufficient water to cover the needs of the household	FGS #98 Proportion of population using safely managed drinking water services SDG 1.4.1 Proportion of households with access to basic services
Average distance of houses to paved roads and ports	SDG 9.1.1 Proportion of the rural population who live within 2 km of an all-season road

Understanding community perceptions of climate change supports the development of effective public policies and robust communication strategies and programmes. Consciousness about climate change has risen over the last few decades in the Pacific, and concern about the reality and severity of climate change is increasing amongst communities.

Factors influencing PICTs communities' perceptions of climate change include the frequency and intensity of natural disasters and climatic-related events, economic factors, education, socio-political events and media coverage. Individuals' perceptions are diverse and encompass sensory perceptions and subjective interpretations, knowledge, awareness and comprehension of the environment, beliefs about ongoing changes, experiences towards climate variability, and concern about its effect.

Individual perceptions of climate change can adversely impact mental health, causing psychological distress and increased rates of psychiatric disorders. Distress can arise from observing modifications to one's environment over time and experiencing an associated sense of loss. This loss may be especially significant for individuals and communities with solid identity bonds to their natural environment, e.g., for Indigenous communities. Messages conveyed through public discourse about the predicted future impacts of climate change, or impacts occurring elsewhere in the world, can also affect individual mental health.

Climate perceptions can influence household coping, mitigation, and adaptation strategies. For example, agricultural households establish significant relationships between climate variability perceptions and coping strategies for soil and water management, crop adjustment and nutrient management strategies. Pessimistic perceptions about climate change may force households to change their productive activity or even displace them.

The Sourcebook therefore includes the following statistics on climate change household perceptions:

- Households' perceptions of the definition and leading causes of climate change
- Perception of threat to households due to climate change in the present and the future
- Household members' feelings when hearing or learning about future climate change impacts
- Main source of information about climate change
- Local Government's management of climate change
- Local Government's communication on climate change.

4. Other dimensions included in the Sourcebook

Natural disasters and climate change have been causing disturbances in critical economic sectors such as agriculture, fisheries, and tourism. In the PICTs, these economic activities have broader connections to income, food security and health. Climatic-related hazards have led to significant threats for the agricultural sector, as they are associated with less predictable or more extreme rainfall events, seawater intrusion and inundation, resulting in the salination of agricultural land, reduced productivity and substantial crop losses.

Moreover, damage to coral reefs and seagrass and mangrove habitats has significantly reduced biological productivity in coastal waters (Pratchett et al., 2005). Climate-related disasters affect tourism by impacting ecosystems, resources and infrastructure, and impacting tourist arrivals after a natural disaster.

Climatic factors are also linked to diet changes over the past two to three decades. Changes are attributed to the decline in consumption of fruits and vegetables; reduced availability of fresh fish and shellfish leading to substitution with canned meat and tuna, eggs and chickens; less availability of seeds and planting material; among other factors. Due to livelihood transitions and climate hazards, households have become less reliant on local fisheries and agriculture for their dietary needs (Medina et al., 2020).

Climate hazards are linked to harmful effects on the health of communities. The spread of diseases caused by consuming contaminated food and water, changes in dietary patterns that have led to a higher prevalence of non-communicable diseases and the threat to mental health are examples.

The Disaster-Related Statistics Framework (DRSF 2018) encourages Disaster Management Agencies to generate direct impact statistics through observations and assessments during and immediately after an emergency as a part of the disaster response. The impacts that cannot be observed directly involve compilations of regular sources of statistics within the NSS, such as the population and housing census, household surveys, and collections of other records of economic activities. However, one of the main challenges for producing impact statistics is attributing particular data to a natural disaster or climatic event. According to DRSF, some statistics can have a direct causal relationship to a disaster, for example, deaths from a catastrophe.

In this sense, human impacts proposed for investigation in the Sourcebook after a natural disaster are: population affected (person deaths or missing, injured or ill) and people’s displacement. These variables could be analysed by geographic regions, hazard types, or demographic categories.

Regarding livelihoods, the impacts proposed in the Sourcebook for measurement are:

- Impacts on employment: number of people affected and the time involved
- Damage to dwellings: economic value of the damage inflicted

- Disruptions to basic services: essential services disrupted, and time involved (electricity, water/sanitation, transport, etc.)
- Impacts on school attendance: number of children not attending school and time involved
- Impacts on agriculture: economic value of the damages inflicted on crops, productive assets, livestock, fisheries, aquaculture, and forestry
- Displacement (migration): number of people forced to displace, either temporarily or permanently and destination
- Early warning information

There is also increasing interest in the connection between **Slow Onset Climatic Events (SOE)** and extreme weather events, and their gradual impacts on human societies. SOE impacts are cumulative and grow over time until significant scale impacts are felt, causing loss and damage to assets and livelihoods and generating particularly adverse effects on vulnerable individuals and groups. Such effects are not easy to measure or address in the short term. Better approaches to address SOE should be part of an integrated process for managing multiple climate risks rather than actions to address a single event. One example is SOE's effects on people's displacement, as they are not regarded as sufficiently extreme to trigger movements since they have a less immediate impact.

For SOEs, the data production approach is to collect data to understand the community's initial situation, followed by monitoring their impacts and measures implemented to boost coping capacity and minimise the impacts on households and communities. Conversely, the SOE areas proposed to cover by the Sourcebook are:

- Household perception of the SOE events affecting their locality
- Impacts occasioned by SOE on households' livelihoods
- Impacts occasioned by SOE on households' health
- Household members pushed to displace because of SOE
- Impacts occasioned by SOE on household's social, cultural and communitarian activities
- Actions taken by households to mitigate/adapt to SOE
- Community actions on adaptation to affront SOE that benefit households.

Preventive and response measures are those aimed at preventing and reducing disaster risk and managing residual risk, all of which contribute to strengthening resilience. The proposed actions to measure by the Sourcebook are:

- Risk prevention in advance of the hazardous event
- Risk prevention in or after a hazardous event
- Structural measures, and constructions
- Non-structural measures
- Land-use planning (e.g., relocation)
- Preparedness measures adopted by households
- Disaster recovery

Climate adaptation strategies adopted in the PICTs are increasingly based on local and community knowledge in combination with innovative science. For example, several household agricultural practices and investments contribute to adapting to climate change and mitigating greenhouse gases (GHGs) related to Sustainable Land Management (SLM) practices, including agro-forestry investments, reduced or zero tillage, use of cover crops, and various soil and water conservation structures. Communities also implement resilient networks of marine protected areas using the best available science and strengthening tribal governance to manage these networks and experimenting

with salt and drought-tolerant crops, revegetating coastlines with native salt-tolerant plants, revitalising traditional wells, and implementing climate-smart development plans (Mcleod, et al., 2019).

The Sourcebook will explore the measures adopted by households attempting to: strengthen or upgrade the infrastructure of the dwelling and the land infrastructure used for agriculture; incorporate technological measures in agriculture (such as agro-forestry, soil management practices, incorporation of salt and drought tolerant crops, selection of animals or species more resistant to heat and diseases); introduce new productive activities, for instance, aquaculture. Communitarian adaptation activities are also of interest, such as the declaration of protected natural areas, revegetation of the coastal areas vulnerable to erosion, revitalisation of traditional wells, etc.

The Sourcebook also aims to capture households' support in designing and implementing climate change adaptation measures. The type of support received, the organisation providing this support, the household's perception of the aid received, and the involvement of household members in adaptation committees are the main statistics proposed for study.

Gender is an essential factor to be considered in how women, and women-headed households, experience and are affected by natural disasters and climate change. In the PICTs, gender gaps are evident in access to services, markets and value-addition activities, land tenure, employment and voice and political participation. These gaps worsen for women living in poverty, exacerbating hardship. Gender differences affect women's vulnerability and minimise their capacity for addressing climate change issues.

Children (mainly young girls) and older women may be more vulnerable during and after a natural disaster. Women and girls have lower levels of access to information and may experience constrained mobility outside their homes. The gender perspective relates to complex elements such as socio-economic status and can serve to increase vulnerability. Hence, integrating a gender perspective into the Sourcebook should go beyond recording the sex of the respondent or household members (Oseni, Palacios-Lopez, Mugera, & Durazo, 2021).

Gender will be addressed by firstly characterising household members (disaggregating respondents by sex and age, inquiring about education level, occupation and disabilities), and secondly, by investigating the impacts of natural disasters and climate change on women and any challenges restricting women to counteract natural disaster impacts and climate change response.

Displacement refers to all types of population movement as a direct consequence of a hazard, including evacuations and permanent relocations. The nature of displacement (and its measurement) varies according to the length of time (e.g., temporary or permanent) and whether displacement was arranged (or ordered or financed) by governing agencies.

Natural disasters and climate change have become significant drivers of displacement from rural to urban areas within PICTs and to other countries (Campbell & Warrick, 2014). Damaged or destroyed dwellings is a common cause of imminent displacement in PICTs after a disaster. Changes in the inhabitants' security in the disaster area also affect decisions to stay, as do impacts on the cash-based and subsistence livelihood or deteriorations in habitat (e.g., water supply quantity or quality loss).

People's movements will vary depending on the speed of climate events, available adaptation opportunities, and household access to resources (Cattaneo et al., 2019). As mentioned, fast-onset extreme weather events (such as cyclones, floods, and landslides) are usually sudden and direct,

resulting mainly in temporary movements over short distances. In contrast, slow onset events are generally not regarded as sufficiently extreme to trigger migration since they have less of an immediate impact on people.

Displacement due to natural disasters could be easily measured, while tracking movements caused by SOEs is challenging. The proposal for the monitoring of displacement through the Sourcebook includes the following:

- Number of household members forced to displace due to natural disasters, either temporarily or permanently,
- Duration and destination,
- Number of household members forced to displace due to SOE,
- Household members relocating as an adaptation measure.

5. Conclusions

The impact of natural disasters and climate change impacts at the household level is inadequately monitored at the global level. Multiple challenges exist in designing and implementing efficient survey programs to monitoring natural disasters and climate change impacts.

This paper presents a Core Module and associated Sourcebook designed for inclusion in household surveys. The two versions with different levels of detail, aim at collecting data for the generation of statistics on key natural disasters and climate change variables.

These versions of the Climate changes modules are a starting point for the development of climate change-related socio-economic monitoring programs that fit the needs of Pacific Island countries and Territories and other Small Island Developing States.

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