Comprehensive Risk & Vulnerability Assessment Methodology for Communities in Fiji

A tool for the Standard Operating Procedures for Planned Relocation in Fiji





Comprehensive Risk & Vulnerability Assessment Methodology for Communities in Fiji

A tool for the Standard Operating Procedures for Planned Relocation in Fiji

© Copyright 2026. Ministry of Environment and Climate Change, Republic of Fiji.

The Comprehensive Risk and Vulnerability Assessment Methodology (CRVAM) is a "living" document and the information expressed in this publication represents the commitment of the Government of Fiji to build a climate resilient nation. The document will be periodically updated to ensure validity, effectiveness, and relevance over time.

The CRVAM was developed under the guidance of the Fijian Taskforce on Relocation and Displacement (FTRD) with inputs from its Technical Working Group.

The development process was led by the Department of Climate Change (DoCC) in the Ministry of Environment and Climate Change with support from the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ) Global Programme - Human Mobility in the Context of Climate Change Programme (HMCCC).

Acknowledgements

The Ministry of Environment and Climate Change would like to acknowledge the valuable contributions from national, regional, and international stakeholders. These include: The Ministry of Rural and Maritime Development and Disaster Risk Management; Ministry of iTaukei Affairs; iTaukei Affairs Board; Ministry of Lands and Mineral Resources; iTaukei Land Trust Board; Ministry of Housing; Ministry of Local Government; Ministry of Public Works, Meteorological Services and Transport; Ministry of Women, Children, Social Protection and Cohesion; Ministry of Fisheries; Ministry of Forestry; Ministry of Agriculture and Waterways; Ministry of Trade, Cooperatives, Small and Medium Enterprises; Ministry of Information; Ministry of Health and Medical Services; Ministry of Education; Ministry of Home Affairs; Fiji Roads Authority; Energy Fiji Limited; Water Authority of Fiji; Fiji Council of Social Services; Soqosoqo Vakamarama iTaukei; Adventist Development and Relief Agency; Save the Children Fiji; Fiji National University; University of the South Pacific; Rainbow Pride Foundation; Fiji Women's Rights Movement; National Trust of Fiji; Pacific Council of Churches; Pacific Disability Forum; Red Cross Fiji; UN Office for Disaster Risk Reduction (UNDRR); Platform on Disaster Displacement (PDD); UN Women; Habitat for Humanity Fiji; UN-Habitat; Fiji Institute of Engineers; United Nations Institute for Training and Research (UNITAR); International Organization for Migration (IOM); Internal Displacement Monitoring Centre (IDMC); Tammy Tabe, Peter Mansson; Olaf Neussen; Erica Bower; Simione Sevudredre; Dr. Glenn Finau; Nacanieli Speigth and Dr. Merewalesi Yee.

The development of the Comprehensive Risk and Vulnerability Assessment Methodology was made possible through the funding provided by the New Zealand Ministry of Foreign Affairs and Trade (MFAT) and the German Federal Ministry for Economic Cooperation and Development (BMZ).

Special recognition

The members of Fiji's Taskforce for Relocation and Displacement (FTRD) wish to honour the memory of the late Christine Fung († November 2024), whose vision, expertise, and tireless dedication played a crucial role in the development of Fiji's Comprehensive Risk and Vulnerability Assessment Methodology (CRVAM) and the Standard Operating Procedures (SOPs) for Planned Relocation.

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Implemented by

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

TABLE OF CONTENTS

Introduction 11

STEP 1 – Define scope and values 17

Step 1.1 – Select Climate Scenarios and Timeslots 18
Step 1.2 – Characterise people and assets 20

STEP 2 – Hazard assessment 25

Step 2.1 – Assess current hazards 26
Step 2.2 – Assess future hazards 28
Step 2.3 – Create hazard-specific scenarios 29

STEP 3 – Exposure assessment 33

Step 3.1 – Assess current and potential adaptation measures 36
Step 3.2 – Visualize exposure 36

STEP 4 – Assess Vulnerability 41

Step 4.1 – Characterise human vulnerability 42
Step 4.2 – Characterise physical vulnerability 43

STEP 5 – Calculate and evaluate risks 47

Step 5.1 – Primary and secondary impacts 51
Step 5.2 – Cut-off times for attributing consequences 52
Step 5.3 – Assess loss of life and health impacts 56
Step 5.4 – Assess displacement and housing losses 57
Step 5.5 – Assess livelihood losses 58
Step 5.6 – Assess environmental losses 59
Step 5.7 – Assess property losses 59
Step 5.8 – Assess Cultural Heritage Losses 61

STEP 6 – Assess adaptation measures 69

Step 6.1 – Assess Adaptation Options using UNFCCC Criteria 71
Step 6.2 – Assess options with Cost-Benefit Analyses (CBA) 73

STEP 7 – Assess potential relocation sites 75

References 79

Appendices 83 -119

Community Risk Mapping: A Step-by-Step GIS Processing Manual for Village Assessments 83

PHASE 0: Workspace Setup & Data Management 83

0.1 The Source Files 83
0.2 Standardised Folder Architecture 83

PHASE 1: Data Preparation and Workspace Setup 84

1.1 Coordinate Reference System (CRS) Alignment 84

PHASE 2: Mapping the Village (Asset Exposure) 85

2.1 Digitizing Building Centroids 85
2.2 Determining the Baseline Water Elevation (Simplified HAND Method) 87
2.3 Sampling Hazard Data in QGIS 90

PHASE 3: Merging Hazard Data with Asset Data 92

3.1 Running the “Sample Raster Values” Tool 92
3.2 Verifying the Data 93

PHASE 4: Calculating Damage and Generating Data Tables 93

4.1 Exporting the Data 93

PHASE 5: Generating Final Cartographic Maps 96

5.1 Setting Up Symbology (Using Data Diagrams) 96

ACRONYMS AND ABBREVIATIONS

AAL	Average Annual Loss
CBA	Cost-Benefit Analysis
CROC	Climate Relocation of Communities Trust Fund
CRVAM	Comprehensive Risk and Vulnerability Assessment Methodology
DoCC	Department of Climate Change of Ministry of Environment and Climate Change
FBOS	Fiji Bureau of Statistics
FCOSS	Fiji Council of Social Services
FEMA	Federal Emergency Management Agency
FMS	Fiji Meteorological Services
FNU	Fiji National University
FPIC	Free Prior and Informed Consent
FTRD	Fijian Taskforce on Relocation and Displacement
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GRM	Grievance Redress Mechanism
IASC	Inter-Agency Standing Committee
IDMC	Internal Displacement Monitoring Centre
INFORM	Index for Risk Management
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre
LH	Livelihood
MRMDDRM	Ministry of Rural and Maritime Development and Disaster Risk Management
MRD	Mineral Resource Department
NDMO	National Disaster Management Office
NELD	Non-Economic Loss and Damage
PDD	Platform on Disaster Displacement
PDNA	Post Disaster Needs Assessment
RCP	Representative Concentration Pathways
SOP	Standard Operating Procedures for Planned Relocation in Fiji
SPC	The Pacific Community
SSP	Shared Socioeconomic Pathway
UNDRR	United Nations Office for Disaster Risk Reduction
UNFCCC	United Nations Framework Convention on Climate Change
UNITAR	United Nations Institute for Training and Research
UNOSAT	United Nations Satellite Centre
USP	University of the South Pacific

KEY TERMS AND DEFINITIONS

Adaptation	In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects (IPCC 2018).
Climate change	A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, and which is in addition to natural climate variability observed over comparable time periods. (UNFCCC, 1992)
Communities	Villages, formal settlements and informal settlements in Fiji that are adversely affected by climate change (Fiji Climate Relocation of Communities Trust Fund Act 2019; Section 2)
Coping capacity	The ability of people, institutions, organizations, and systems, using available skills, values, beliefs, resources, and opportunities, to address, manage, and overcome adverse conditions in the short to medium term (IPCC).
Cost–benefit analysis	Monetary assessment of all negative and positive impacts associated with a given action (IPCC, 2022a).
Disaster	A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability, and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts. (UNDRR, 2020). UNDRR also differentiates between slow and sudden onset disasters. Slow-onset disasters emerge gradually over time and could be associated with, e.g., drought, desertification, sea-level rise, epidemic disease. Sudden onset disasters emerge quickly or unexpectedly and could be associated with, e.g., earthquake, volcanic eruption, flash flood, chemical explosion, critical infrastructure failure, transport accident.
Disaster displacement	Disaster displacement refers to situations where people are forced to leave their homes or places of habitual residence because of a disaster or to avoid the impact of an immediate and foreseeable natural hazard. Such displacement results from the fact that affected persons are exposed to a natural hazard in a situation where they are too vulnerable and lack the resilience to withstand the impacts of that hazard. (Platform on Disaster Displacement)
Disaster risk	The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society, or a community in a specific period, determined probabilistically as a function of hazard, exposure, vulnerability and capacity. (UNDRR, 2020)

Disaster Risk Assessment	A qualitative or quantitative approach to determine the nature and extent of disaster risk by analysing potential hazards and evaluating existing conditions of exposure and vulnerability that together could harm people, property, services, livelihoods and the environment on which they depend. (UNDRR, 2020)
Exposure	Exposure is who or what is in harm's way.
Hazard	The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources. (IPCC 2014, AR5/ WG2)
Nature-based solutions	Actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human wellbeing and biodiversity benefits. (IUCN, 2016)
Planned relocation	A solution-oriented measure, involving the State, in which a community (wholly or partially, and as distinct from an individual/ household) is physically moved to another location and resettled permanently there.
Precautionary Approach	A course of preventive measures taken to avoid serious or irreversible harm to people or the environment even if scientific evidence is inconclusive.
Representative Concentration Pathways	These are used in climate science to describe different scenarios based on future greenhouse gas emissions and climate outcomes. Low, intermediate and high emissions pathways can be used.
Risk	Risk = Probability of a hazard x Exposure x Vulnerability
Shared Socioeconomic Pathway	This is used in climate science to project how population growth, economic progress and technological, energy and environmental considerations impact climate outcomes.
Structural and non-structural measures	Structural measures are any physical construction to reduce or avoid possible impacts of hazards, or the application of engineering techniques or technology to achieve hazard resistance and resilience in structures or systems. Non-structural measures are measures not involving physical construction, which use knowledge, practice or agreement to reduce disaster risks and impacts, in particular through policies and laws, public awareness raising, training and education. (UNDRR, 2020)
Vulnerability	Vulnerability is how likely people and/or systems are to be harmed by a hazard



INTRODUCTION

The Comprehensive Risk and Vulnerability Assessment Methodology (CRVAM) is a standardised, whole-of-government approach for assessing climate-related and other relevant disaster risks, vulnerabilities and community capacities in the context of planned relocation in Fiji. It supports evidence-based decision making on appropriate risk-reduction and adaptation measures, including whether planned relocation may be necessary as a measure of last resort, and whether potential relocation sites are suitable. The methodology considers physical, social, economic, environmental and cultural dimensions to help ensure that decisions are informed by the needs, priorities and values of affected communities and support safety, dignity, cultural continuity and long-term resilience.

The CRVAM recognises that planned relocation is a measure of last resort and should be considered only after assessing the effectiveness and feasibility of other risk-reduction and adaptation options. Decisions must be informed by current and projected risks, the potential consequences of different interventions, and their social, economic, environmental and cultural implications. The methodology therefore combines scientific and technical evidence with government data, field assessments and community knowledge to support informed, inclusive and transparent decision-making.

Fiji' s Standard Operating Procedures (SOP) for Planned Relocation (2023) establish the CRVAM as a mandatory component of the relocation process. The methodology supports three key steps of the SOP:

- **Step C – Preliminary Screening, Scoping and Initial Risk Assessment:** The CRVAM provides the structure for early identification of hazard exposure, sensitivity, and adaptive capacity, ensuring that initial decisions are evidence-based.
- **Step D – Comprehensive Climate Risk and Vulnerability Assessment**: The CRVAM is the detailed methodology used to conduct the full assessment required under this step, including fieldwork, community consultations, sectoral analyses, and risk modelling.
- **Step E – New Site Confirmation:** The CRVAM guides the comparative assessment of potential relocation sites, ensuring that new locations are safer, viable, and culturally appropriate.

The CVRAM addresses the three core elements of risk: hazards, exposure and vulnerability. While focusing primarily on climate-related risks, it also considers other relevant natural hazards, including geophysical hazards, to support a comprehensive assessment of community safety and appropriate risk-reduction options.

Why is the CRVAM needed?

Planned relocation is a **measure of last resort** and should only be considered after other feasible adaptation options have been exhausted. The SOP requires that all decisions are grounded in robust evidence. Without a consistent assessment methodology, decisions risk being fragmented, inconsistent or insufficiently grounded in evidence. The CRVAM provides a systematic basis for assessing risks and vulnerabilities, evaluating alternative adaptation measures and ensuring that decisions are informed by Fiji's legal, cultural and human rights obligations.

The overall objective of the CRVAM is to provide a consistent and systematic basis for assessing risks and vulnerabilities and informing decisions on appropriate risk-reduction measures, including planned relocation where necessary.

Its specific objectives are to:

1. Identify and assess current and projected climate-related and other relevant natural hazards, including their likelihood, intensity and potential impacts.
2. Assess the exposure and vulnerability of communities, people, livelihoods, infrastructure, ecosystems, assets and culturally significant places and values.
3. Assess the effectiveness, suitability and feasibility of adaptation and other risk-reduction measures before relocation is considered.
4. Identify and assess the risks and suitability of potential relocation sites, where relocation is being explored under the SOP.
5. Provide a consistent evidence base to support transparent, participatory and accountable decision-making throughout the planned relocation process.

Who is the CRVAM for?

The CRVAM is designed for the following actors involved in planned relocation:

- **Government ministries and statutory bodies** engaged in climate adaptation, disaster management, land administration, infrastructure, social services and community development.
- **Divisional and provincial offices**, who support fieldwork, community engagement, and inter-agency coordination
- **Technical specialists**, including engineers, planners, modellers, social scientists, cultural experts, and environmental officers.
- **Civil society organisations, development partners and academic institutions** providing technical assistance, facilitation, research of capacity building.

Affected communities and potential host communities are essential participants and contributors to the assessment process. Their knowledge, experiences, priorities and values inform the assessment, help identify appropriate adaptation options and contribute to the validation of findings. Assessment results should be communicated in accessible formats to support their informed participation in decision-making.

How to use the CRVAM

The CRVAM is structured to be used step-by-step, aligned with the SOP phases. Users should:

- **Follow the assessment steps:** Apply the seven steps systematically, completing the relevant activities in accordance with the SOP and the requirements of the assessment. Where necessary, revisit earlier steps to incorporate new information or refine findings.
- **Use the supporting tools and templates:** Refer to the fieldwork guides, assessment templates, data collection tools and reporting formats provided in the methodology to promote consistency, transparency and quality across assessments.
- **Integrate community participation and safeguards:** Incorporate community consultations, appropriate cultural protocols and relevant free, prior and informed consent (FPIC) processes throughout the assessment, in accordance with the SOP and applicable guidance.
- **Document findings and evidence:** Record assessment methods, data sources, assumptions, findings, uncertainties and limitations clearly. Reports should provide a traceable evidence base to inform decisions on risk-reduction measures, potential relocation sites and subsequent relocation planning.
- **Support coordination and capacity building:** Use the CRVAM as a reference for training, quality assurance and coordination among the government agencies, technical specialists and other stakeholders involved in the assessment.

The methodology is designed to be practical, adaptable, and usable by multidisciplinary teams. Each step sets out its purpose, links to the SOP, required inputs, community participation, roles and responsibilities, expected outputs and links to subsequent steps. Technical guidance and supporting tools are provided in the appendices where applicable.

Approaches to Applying the CRVAM

The CRVAM should be applied in accordance with the **principles of the SOP** (Section I – 4) and its supplementary tools, including the Guiding Frameworks for Cultural Considerations, FPIC and Gender Equality, Disability and Inclusion (GEDSI), as well as the Grievance Redress Mechanism. These frameworks provide complementary guidance to ensure that assessments are ethical, inclusive, and culturally grounded.

The following approaches explain **how** the methodology should be applied:

- **Participatory** — Communities are central to the assessment. Their knowledge, priorities, cultural values, and lived experiences shape the analysis and recommendations. The selection of stakeholder representatives should be transparent.

- **Flexibility and Continuity** — The methodology can be adapted to different contexts, scales, and hazards, while maintaining continuity across the SOP stages. Existing studies, assessments, datasets and community consultations should be used where relevant to build on previous work, identify remaining information gaps and avoid unnecessary duplication.
- **Alignment to International Standards of Risk Assessment** — The CRVAM integrates IPCC-aligned risk concepts, disaster risk reduction frameworks, and human rights-based approaches.
- **Data quality and uncertainty** – Assessments should draw on the best available scientific evidence, government data and community knowledge. Data gaps, assumptions and uncertainties should be documented and clearly communicated when presenting and interpreting findings.
- **Living Document** — The methodology will evolve as new data, technologies, and lessons emerge. It is designed to be updated periodically, ensuring relevance and effectiveness over time.

How was the CRVAM developed?

The CRVAM was developed through a multi-year, multi-stakeholder process that began in 2019, parallel to the development of the SOP. The process reflects Fiji's commitment to building a nationally owned, technically robust system for managing climate-induced mobility.

Key elements of the development process include:

- Series of technical working group sessions under the Fijian Taskforce on Relocation and Displacement (FTRD), involving government agencies, statutory bodies, and partners.
- Extensive consultations with communities, provincial offices, civil society organisations, representatives of affected communities and technical experts.
- Engagement of national and international specialists on displacement and planned relocation, non-economic loss (NEL), culture and traditional knowledge, and disaster risk modelling to ensure multidisciplinary rigour.
- Training of TWG members to build national capacity for applying the methodology.
- Piloting exercises in Nabavatu and Vuniniudrovu, which tested the methodology's practicality, cultural appropriateness, and alignment with community expectations.
- This collaborative and consultative development process has helped ensure that the CRVAM is grounded in Fiji's realities, informed by global best practice, and refined through practical application.

Structure and Overview of the CRVAM

The CRVAM is organised into seven interrelated steps, supported by sub-steps, assessment guidance and relevant tools. Together, these steps guide users through the identification and assessment of hazards, exposure and vulnerability; the evaluation of risk-reduction and adaptation options; and, where necessary, the assessment of potential relocation sites. The sequence and interdependencies of the seven steps are illustrated in Figure 1 below.

The CRVAM draws on the following main assessment types that are woven into every step:

1. **Desk review and analyses**
   i. Review of grey literature
   ii. Assessment and monitoring reports from government
   iii. Assessment and reports from other organisations and projects
   iv. Research papers from academic institutions

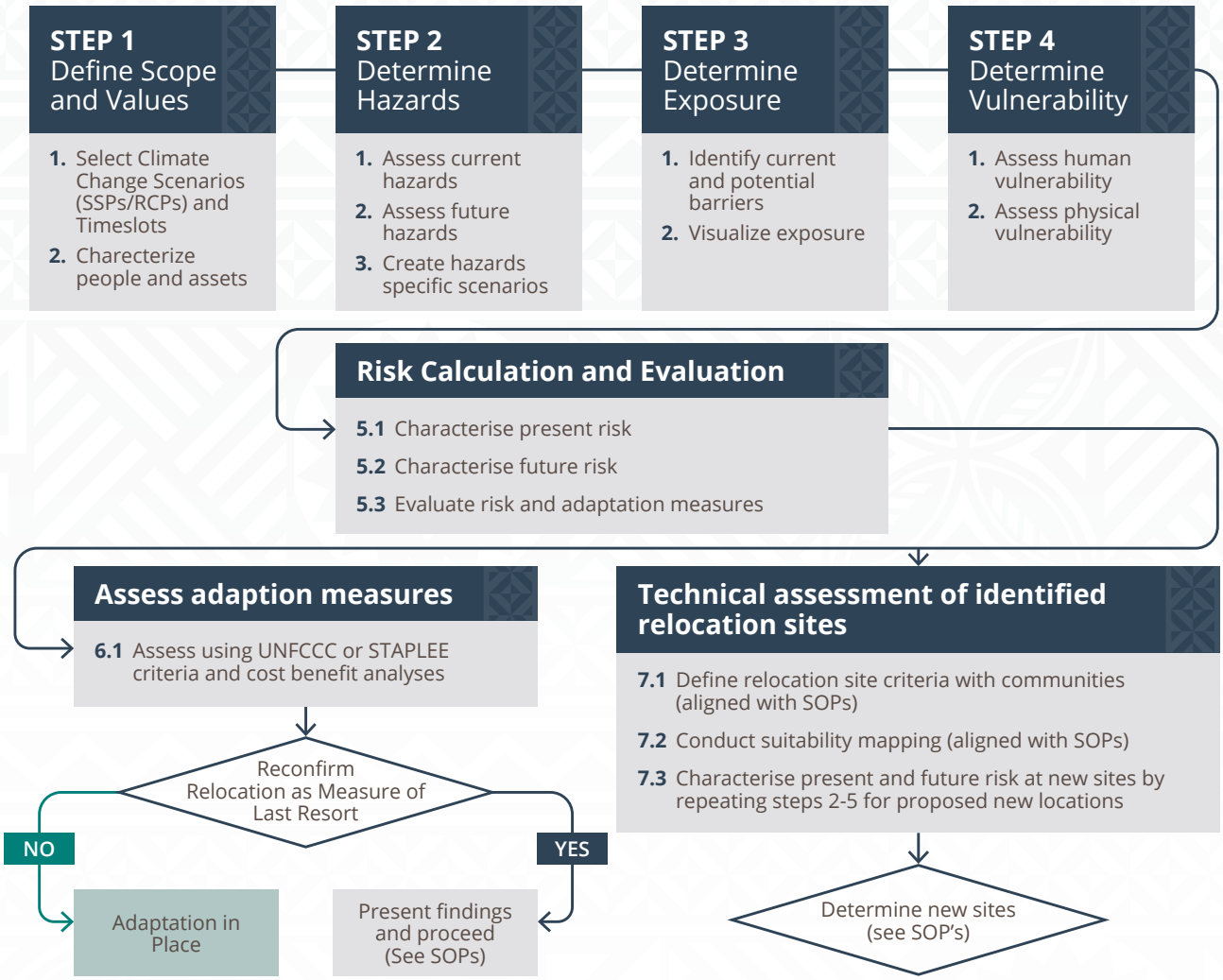
2. **Field research and analyses**
   i. Field mapping
   ii. Technical surveys
   iii. Community assessment and survey (including KOBO toolbox or ArcGIS)
   iv. Ground truthing / validation of desk information

3. **Climate data and scenarios**
   i. Representative Concentration Pathways (RCPs)
   ii. Shared Socioeconomic Pathway (SSP)
   iii. Timeframe
   iv. Downscaling to regional/community level

The quality and availability of data in support of assessments are crucial in determining the types of methodologies that can be used (assuming that useful data exists and is readily shared amongst relevant stakeholders). Deficiencies regarding some datasets will reduce the quality of the assessment. Historical records of losses/damages are often sparse and, hence, many hazard and risk data need to be derived from global sets with a low spatial resolution. As a result of data availability/quality issues, the risk estimations are prone to significant error margins. These risk estimations will need to be verified through local observations, community knowledge and site observation and any resulting differences will be documented.

The three assessment types above should provide the background information for the seven CRVAM steps. Refer to each step for examples of how this information is used.

Figure1: CRVAM Steps



STEP 1

DEFINE SCOPE AND VALUES



STEP 1 – DEFINE SCOPE AND VALUES

Purpose

- Define why the assessment is being undertaken, which communities and geographic areas it covers, and the baseline and future periods to be assessed.
- Identify the people, assets, and community values that need protection, including values that cannot be expressed in monetary terms.

This establishes the climate scenarios and time horizons used to compare present and future risk. Considering a range of climate futures supports assessment of how risks may change over time and informs decisions on adaptation and potential relocation.

Link to the SOP

This step supports Phase C of the SOP, covering preliminary screening, scoping and initial risk assessment, as identified in Chapter 4.3.

Inputs required

- Use the community's request or other documented basis for assessment, existing community and village profiles, census information, land and asset records, maps and imagery, previous assessments, and relevant climate projections.
- Review existing consultation records and identify whose perspectives or information are missing.
- Establish the assessment team and the arrangements for community engagement and information management.

Assessment activities

STEP 1.1 – Select Climate Scenarios and Timeslots

The initial step of the CRVAM focuses on defining the purpose of the assessment and its spatial and temporal scope. It identifies the communities to be assessed, the climate change projections, the assets (both tangible and intangible) that need protection and their values. The degree of exposure to risk and the vulnerability of these assets are then assessed and their subsequent values are determined according to these different scenarios. Decisions are then taken by the Government of Fiji (the instigator of the assessment) after discussions with the assessment team and in consultation with the at-risk communities.

Assessing the Non-Economic Loss and Damage (NELD) is also a critical part of the assessment because it considers the components that are not easily quantified in monetary terms; these include loss of life, human health, cultural heritage, traditional knowledge, biodiversity and ecosystem services. The methodology is explained in Section 5.8.

The assessment compares current risk of the communities with the risk they may face due to climate change in the future. The Fiji Meteorological Services (FMS) has developed climate scenarios for the whole of Fiji (though not detailed for specific islands or communities) for multiple time slots: 2030, 2050, 2070 and 2090[1]. Multiple time slots should be considered to understand how climate change impacts are likely to evolve over time, including a near term year (e.g., 2030) that is meaningful for people's immediate lives, a mid-term year that is imaginable yet still distant (e.g., 2050) and a long-term year to provide an opportunity for long-range planning (e.g., 2100).

The assessment should also compare a range of possible climate change futures, as the socioeconomic and political path of the planet is not predetermined. Multiple emissions scenarios, known as RCPs/SSPs should be used. The assessment will use a low emissions pathway (SSP 1 - RCP 2.6), an intermediate pathway (SSP 2 – RCP 4.5) and a high emissions pathway (SSP 3 – RCP 8.5).

BOX 1 - RCP and SSP

Representative Concentration Pathways (RCP) are greenhouse gas concentration trajectories adopted by the Intergovernmental Panel on Climate Change (IPCC). RCPs are labelled after a possible range of radiative forcing values in the year 2100 and are used as a basis for climate modelling and research.

From the IPCC's sixth assessment report (published in 2021) onwards, the international research community, and also the Fijian Meteorological Office, have moved towards an approach that integrates RCPs with a set of scenarios known **as Shared Socioeconomic Pathways (SSPs)**. SSPs consider the context of the underlying social and economic factors that can produce each emissions pathway.

SSP 1 – RCP 2.6 presents a low emissions scenario where CO_2 emissions decline to net zero at around 2070 followed by net negative emissions,
SSP 2 – RCP 4.5 represents an intermediate scenario where emissions remain at current levels until the middle of the century,
SSP 5 – RCP 8.5 represents a very high emissions scenario where emissions double from current levels by 2050,

When interpreting the range of outcomes, it is wise to strike a balance between a precautionary approach and the risk of being too cautious. Planned relocations are a major effort requiring substantial resources and causing significant psychosocial and cultural loss; if the most extreme SSP 5 - RCP 8.5 is the only scenario considered, this might lead to more relocations and undermine the "measure of last resort principle".

1 https://www.met.gov.fj/climate-services/climate-change/

Conversely, if only SSP1- RCP 2.6 is considered, key climate impacts may not be anticipated. Therefore, if resources are available, a range of pathways should be considered, as a foundation for the development of risk scenarios in Step 2.

STEP 1.2 – Characterise people and assets

Having defined which communities should be assessed, one also needs to define what, in these communities, are important to protect, such as people's lives and health, property and homes, livelihoods, the environment upon which they depend and the cultural heritage that provide a sense of identity and belonging.[2] Such values are often – as also proposed in this

case - transferred to consequence dimensions, i.e., types of consequences that are to be assessed (Step 5). Yet, given that values are contextual, one may want to use other consequence dimensions than proposed here. The guide allows for this but stresses the need for using common dimensions, assessment levels (e.g., 1-5) and indicators for these to ensure that the outputs of assessments will be comparable over time and across different assessors.

National statistics (census data, cadastre/land registries and land use/cover data) can be used to identify the number and location of people and buildings in the communities as well as lands that may be used for livelihood purposes. To assess and compare potential damages to property in different communities, it is necessary to define a set of common asset categories covering physical objects that provide essential functions for the safety and wellbeing of communities at large. Such categories may comprise:

- Homes
- Community buildings (schools, health clinics, churches)
- Energy sources (power plants, power lines, transformation stations)
- Water sources, treatment plants and pipelines
- Telecommunication (masts)
- Roads
- Bridges
- Ports (Jetties)
- Assets to sustain livelihoods (e.g., arable lands, livestock, fishing boats and equipment)
- Traditional House mounds (*yavu*), burial grounds and traditional groves (*sau tabu*)
- Traditional houses at the old site
- Grounds used for subsistence or livelihood purposes (*ikanakana*)
- Oral traditions and expressions
- Traditional rituals and protocols
- Traditional craftsmanship
- Traditional social structures

These categories have been incorporated into community surveys, which can be used as basis for community consultations (Step 4.1) along with questions on the number, type, material, location and estimated worth of these assets.

2 Even though the objective is to analyse and compare the communities' present risk with the risk level they may face due to climate change in the future, the CRVAM assumes the current figures of valuable assets also for assessing the communities' prospective risk levels. The reason for this is twofold. First, it avoids introducing large uncertainties into the analysis about the potential development of different communities. It also simplifies and speed up the analysis, which is particularly rational if it can be assumed that all communities will develop along similar paths (whether growth or decline of population and assets).

The Ministry of iTaukei Affairs has published village profiles which would also be a starting point for information on demographics, physical structures, challenges and aspirations. The Village Profile URL link is as follows: https://public.tableau.com/views/FijiVillageProfile2023/CoverPage?:language=en-US&:sid=&:redirect=auth&:display_count=n&:origin=viz_share_link



The answers to these questions are essential for estimating how exposed communities are to different hazards (Step 3), the physical vulnerability assessments and damage calculations (Steps 4 & 5) and the cost-benefit analysis of adaptation measures (Step 6). Much of this information can be obtained before visiting the communities as information about assets can often be derived from statistics (e.g., cadastre/land registries showing the location, owners, and characteristics of various structures). This work would then be part of the desk study mentioned in the SOP (Phase C, Section III step 7 – Page 25). In the steps relating to Hazard Assessment, Exposure Assessment and Vulnerability Assessment, the agencies are responsible for providing specific data and / or information (see Table 1).

Table 1. Agencies and respective roles

Government Ministry/ Agency	Support Role
Ministry of Environment & Climate Change (MECC)	Provides overall institutional climate change policy and mobilisation of support where possible, manages funds for relocation and chairs the Fijian Taskforce on Relocation and Displacement of Communities Vulnerable to the Impacts of Climate Change (FTRD) MECC is also responsible for the development of the National Adaptation Plan as well as oversight and audit of the CROC Trust Fund.
Ministry of Rural & Maritime Development and Disaster Risk Management (MRMDDRM)	Lead agency for the implementation of the Standard Operating Procedures (SOP) for Planned Relocation. Serves as Secretariat for the FTRD. Responsible for compilation of workplan, associated budgets as well as acquittals. Focal point for communities and other agencies and partners, housing designs and vetting of contractors, tender processing.
Ministry of Finance, Strategic Planning, National Development and Statistics	Census data from Bureau of Statistics. Ministry of Finance has legal mandate to release funds from CROC Trust Fund for relocation work.

Government Ministry/ Agency	Support Role
Ministry of iTaukei Affairs	Village Profiles of all 1172 villages; regular communication with the communities through Provincial Office on all matters relating to relocation process; compilation of info on history of risks and hazards experienced by the village. Responsible for conflict resolution (GRM), negotiation of land acquisition, demarcation of village boundaries, registration of new village boundaries, confirmation of new registered landowners, identification of land-owning units, focal points for communities and other agencies and partners.
Ministry of Lands & Mineral Resources	Cadastre/land registries and land use/cover data. Hydrogeological surveys by Mineral Resources Department to determine water sources, water quality and abstraction. Geological and geotechnical assessments to determine rock types and ground stability. Responsible for assessment of current and new sites, seismic assessment and monitoring, coastal assessment.
Ministry of Public Works, Meteorological Services and Transport	Assessment of all essential infrastructure including roads, bridges, sewer lines, drains. Statutory Bodies include Fiji Roads Authority, Energy Fiji Limited and Water Authority of Fiji.
Ministry of Housing	Responsible for the relocation of informal settlements under the Informal Settlements Upgrade Project. Works in close collaboration with MRMDDM on implementation of SOP. Custodians of housing policy, has own housing designs.
Ministry of Women, Children and Social Protection	Address the needs of women, children, elderly and people living with disabilities in all stages of the SOP (pre- and during) including post-relocation monitoring to mitigate social risks. GRM – referral system.
Ministry of Forestry and Fisheries	Assess impacts of relocation on forest and fisheries resources at the new site and assess access to resources for sustainability of livelihoods. Forest inventory for high forest cover areas to determine species composition and timber volume if forest products are to be source of livelihood. Responsible for capacity building and estimate of volume of timber as contribution of communities.
Ministry of Agriculture and Waterways	Technical assessment of soil suitability, crop viability and water resources for post-relocation agricultural activities. Responsible for livelihoods assessment, training and capacity building, farmer census, climate resilient agriculture, sustainable land management, farm roads and accessibility, livelihoods assessment, implementation of coastal protection, land classification, implement coastal protection and riverine stabilisation measures to safeguard communities and infrastructure from erosion and rise in sea-level.
Ministry of Health & Medical Services (MHMS)	Responsible for health risk assessments including sanitation and water quality in current site and new site monitoring health impacts, both physical and mental, post-relocation.

Government Ministry/ Agency	Support Role
Ministry of Education, Heritage and Arts (MoEHA)	A supporting role in ensuring continuity of education services for affected children. Also assesses and preserves important cultural sites, artifacts and traditions at risk from relocation ensuring their documentation and where possible, replication at the new site to preserve cultural identity.
Fiji Roads Authority	Assessment of road network and types
Energy Fiji Limited	Connection of houses to grid. If off-grid, installation of solar in relocation site. Installation of low energy/energy efficient fixtures in houses and outside areas to be well illuminated for safety.
Water Authority of Fiji	Conduct water resource assessments and installation of water systems in relocation sites.
Civil Society Organizations	
Fiji Council of Social Services	Secured external funding for relocation of Cogea Village in Bua and coordinated house design and construction with external donors and Govt agencies.
Fiji Council of Churches	Church-Based Risk and Disaster Management (CBRD) training; community consultations
Academia	
University of the South Pacific	Research on impacts of climate change and on relocation.
Fiji National University	Research
CROP Agencies	
Pacific Community (SPC)	Technical advice on livelihoods
Secretariat Pacific Regional Environment Programme (SPREP)	Technical advice

Community participation and validation

Discuss the assessment purpose, boundaries, proposed methods and intended use of information with the community. Include opportunities for women, men, young people, older people and persons with disabilities to identify what matters to them. Respect local governance and cultural protocols while enabling people whose views may be less visible to contribute. Check the inventory and maps with community members and agree how sensitive cultural and personal information will be recorded, accessed and returned.

The survey, field observations and focal group discussions with at-risk communities will help to fill in gaps in available statistics. The location of the assets can also be mapped with the help of an app in a mobile phone or iPad (e.g., KOBO toolbox, ArcGIS Field Maps) that enables the transfer of the locations to a GIS-program where it can be further analysed[3]. The location of assets should preferably be derived from detailed maps and/or images (satellite or drone photography, open street map (OSM)).

3 Information about ArcGIS Field Maps can be attained from https://www.esri.com/en-us/arcgis/products/arcgis-field- maps/overview. Free online tutorials can be found at https://www.esri.com/training/catalog/search/

Each of the ensuing steps has different agencies taking the lead and others playing a support role in Box 2

BOX 2 – Roles and Responsibilities

Lead (L) & Supporting Agencies (S)
1.1 (part 2) Select Climate Change Scenarios (Time Slots & RCP/SSPs)
L: Fiji Meteorological Services
S: Department of Climate Change (DoCC), Min. Lands and Mineral Resources (landslides), United Nations Satellite Centre (UNOSAT); Internal Displacement Monitoring Centre (IDMC), The Pacific Community (SPC); University of the South Pacific (USP); Fiji National University (FNU)
1.2 Characterise/Quantify People & Assets
L: Min. Rural and Maritime Development & Disaster Risk Management / Min. iTaukei Affairs; iTaukei Affairs Board; Fiji Roads Authority (FRA); Energy Fiji Limited (EFL); Water Authority of Fiji (WAF)
S: DoCC, Fiji Bureau of Statistics, Ministry of Housing, Min. Lands and Mineral Resources; Min. Public Works, Meteorological Services & Transport; Ministry of Finance; Ministry of Multi-Ethnic Affairs and Sugar Industry; Min. of Women, Children and Social Protection; Min of Agriculture, Min of Forests and Fisheries, Fiji Council of Social Services (FCOSS), Fiji Museum (Heritage Sites), Min. of Education, Heritage and Arts (supporting UNICEF), Min Health & Medical Services (Statistics), Pacific Council of Churches, Fiji Council of Churches (CBRD training, community consultations)

Outputs

A finalized scope of the assessment, specifying its purpose, geographic coverage, climate scenarios, timeslots, and the people, assets (both tangible and intangible) and community values to be assessed. Supporting documentation includes the community profile, mapped inventory, engagement records, data sources, information gaps and assumptions. The scope and supporting records should be reviewed and updated where new evidence or changing circumstances requires.

Link to the next step

Step 2 uses the agreed scope, scenarios and inventory to identify and characterise relevant hazards. The inventory is also carried forward to the exposure assessment in Step 3, vulnerability assessment in Step 4 and consequence assessment in Step 5.

STEP 2
HAZARD ASSESSMENT



STEP 2 – HAZARD ASSESSMENT

Purpose

- Define assets that need protection.
- Identify hazards that may threaten these assets. The content of the risk analysis will be determined here. Hazards that are not identified will not be analysed which can lead to the underestimation of certain risks and the need for certain risk reducing measures.
- Delimit the assessment to the main prevailing hazards with an upper limit of ten hazards. The effort of analysing a hazard is considerable and therefore should be restricted to the most significant hazards for the sake of efficiency.

The CRVAM uses empirical data, stakeholder consultations and research to identify and characterize the most prominent hazards in Fiji (Step 2.1) and how they may evolve over time (Step 2.2). This knowledge also provides input to the creation of hazard-specific scenarios (Step 2.3) that are used as a basis for the risk calculations in Step 5.

Link to the SOP

This CRVAM step supports SOP steps 7 and 8 of phase C (chapter 4.3. Preliminary screening, scoping, initial risk assessment Section III, Page 25, 26) and SOP step 11 of phase D (chapter 5. Pre-stage II: Detailed assessment & planning Section III, Page 32).

Inputs required

- Use the Step 1 scope, inventory and scenario register; historical disaster and loss records; community accounts; hazard maps; topographic, geological and environmental data; climate observations and projections; and relevant scientific and government assessments.
- Review the hazard mapping procedures in Appendix 1 where applicable.

Assessment activities

STEP 2.1 – Assess current hazards

Desinventer Pacific provides disaster information management data for the Pacific region and provides information on causes, impacts, damages and losses of hazardous events that have occurred in Fiji between 1840 and 2021. The main hazards in Fiji are cyclones, floods, landslides, earthquakes, tsunamis, wildfires, and droughts (UNDRR, n.d.).

The following hazards can be included in the assessment:

- Riverine floods
- Flash floods
- Coastal floods
- Wind/storms (including cyclones)
- Storm surges
- Coastal inundation
- Coastal erosion
- Riverbank erosion
- Ocean warming (coral bleaching) / Ocean acidification
- Landslides
- Droughts
- Tsunamis[4]
- Earthquakes[5] (Peak ground acceleration (PGA - experienced on the ground) is a method of showing Earthquake hazard. Another method is Spectral Acceleration (SA - experience by a building). And the g, is g-force or Earth gravity)

In case other hazards are regarded as important, they may be added and assessed too. It is recommended to select hazards that specifically apply to the at-risk community after consultations with the community, scientists, and government officials and how the hazard feeds into the multi-hazard risk score.

Hazards are characterized by a mix of scientific and community-based methods. The latter are preferred for frequent events where community members can describe or quantify the nature of hazards from their own experience while scientific data might be used for rare events where such community experiences are lacking[6]. When both are available, the information should be crosschecked and verified.

The hazards are characterized with a set of data reflecting the severity, spatial extent and corresponding probability. As much as possible, the severity is described in quantitative categories (e.g., meter flood height, km/hour wind speed), while the probability may be stated as annual return periods (also known as a recurrence or repeat intervals, which express how many years are expected between the occurrence of specific hazardous events) or as annual probability (the chance of an event in one year). Refer to Table 2.

4 Tsunamis are not caused by hydrological or meteorological events, but their impact is increased with climate change related sea level rise.
5 Even though earthquakes are not induced by climate change, they need to be considered when assessing the suitability of relocation sites as one would not like to move to an earthquake prone area.
6 If feasible, historic, and scientific (modelled) data hosted by national hydro-met services and other national agencies and authorities could be used, which would save time.

The categories for return periods for the risk assessment matrix are:

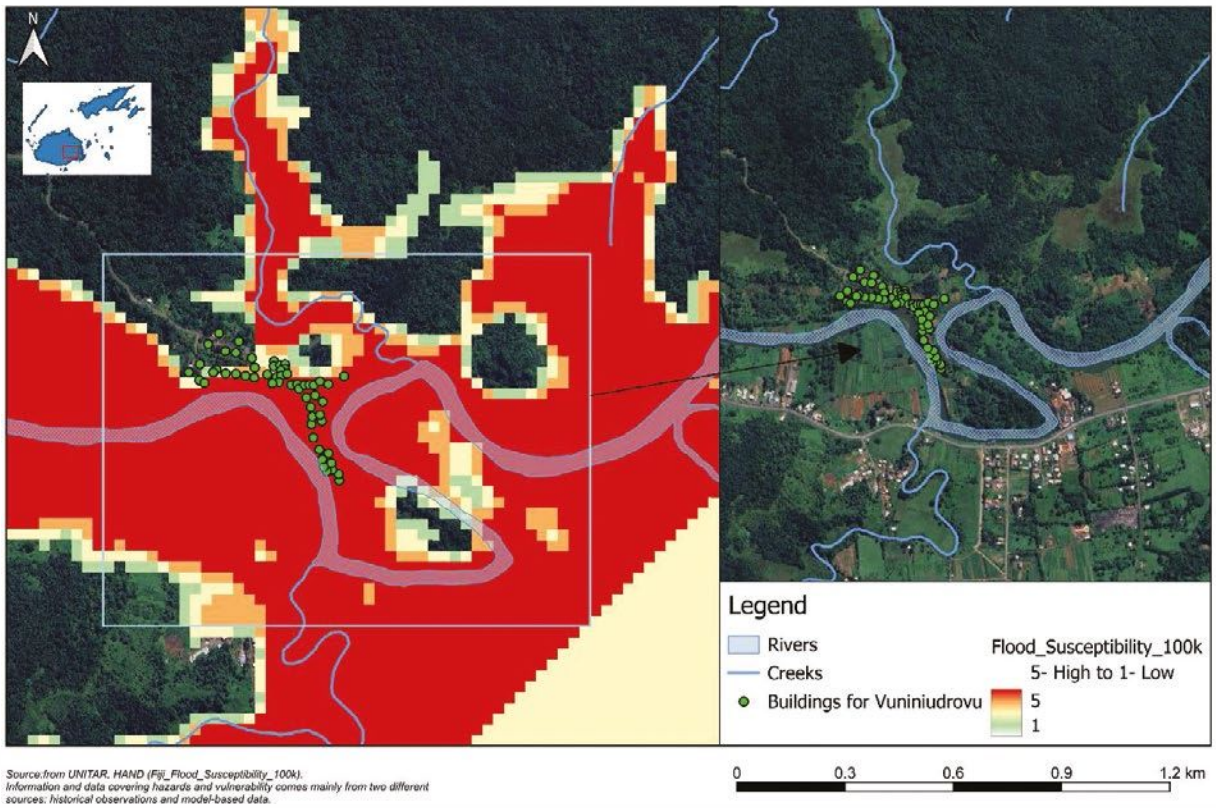
Table 2. Levels and indicators for assessing likelihood of hazards.

Score	Return periods
5 (very high)	≤10 years
4 (high)	>10-30 years
3 (medium)	>30-50 years
2 (low)	>50-100 years
1 (very low)	>100 years

STEP 2.2 – Assess future hazards

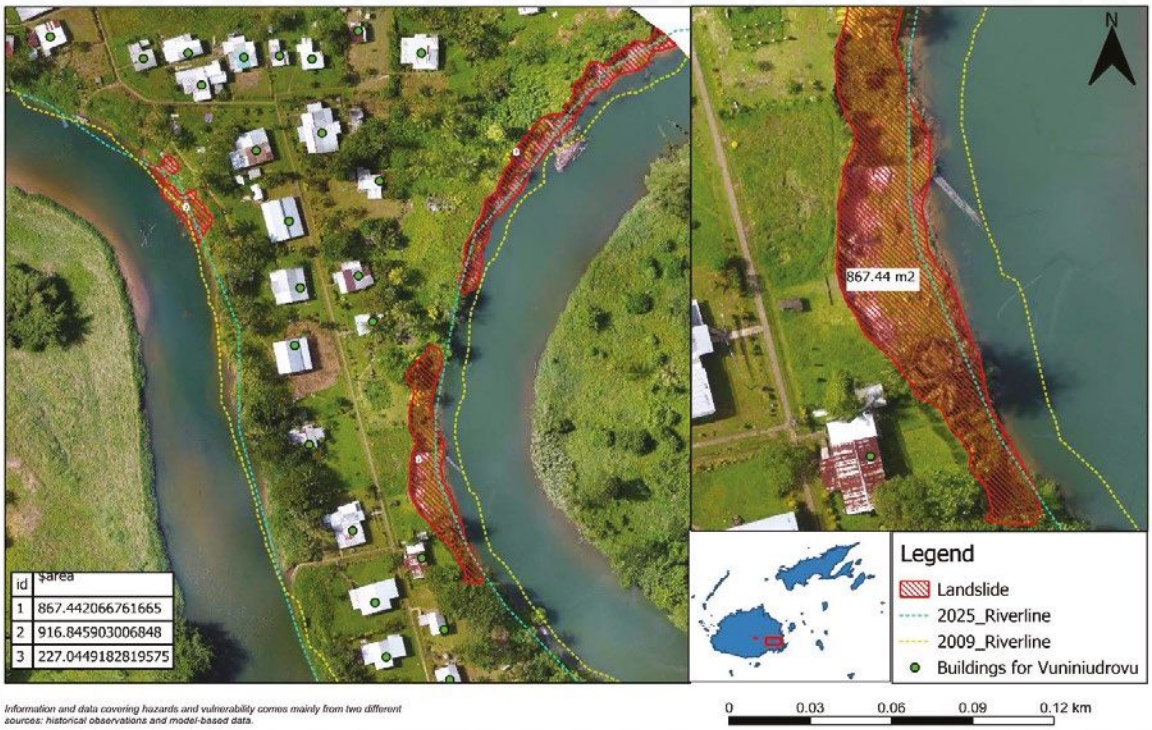
Here we estimate whether - and if so, how - the hazards identified in Step 2.1 may change (in terms of likelihood and intensity) over time in Fiji i.e., according to the range of RCPs/SSPs and time slots that were decided in Step 1.1. To this end, one may utilize (and, if needed, extrapolate) projections already made by national authorities such as the Fiji Meteorological Services (FMS) and climate research[7]. Figure 2a shows a GIS map of Vuniniudrovu and its susceptibility to riverine floods and Figure 2b is a GIS map showing land loss due to flooding.

Figure 2a: Flood Susceptibility - Vuniniudrovu



7 Such projections have, for instance, been presented in CSIRO and SPREP (2021) and Bloemendaal et al. (2022), but a more in-depth scrutiny of these projections and other studies are needed to select the projections that are most aligned with the chosen RCPs and time slots for the assessment.

Figure 2b: Vuniniudrovu



STEP 2.3 – Create hazard-specific scenarios

As clarified by the section on risk calculation (Step 5), probabilistic data and vulnerability/damage curves will render losses in financial worth of property expressed as Average Annual Losses (AAL[8]). Yet, it is difficult to assess everything in monetary terms by help of predefined models (e.g., consequence dimensions such as lives, cultural heritage, and some environmental assets). For this reason, hazard specific scenarios should be developed, and these dimensions be assessed by using a mix of disaster loss statistics and "expert judgement".

In these scenarios, the hazard intensity should be "moderate" since these have proven to generate the most losses over time and aligns better with the AAL calculations, which are providing mean values based on different intensities (and, hence, will return a "moderate" value). To be able to compare the current and future risk of a specific location, three different scenarios per hazard type needs to be developed which differ with regards to hazard intensity/severity according to the projected changes of the chosen timeslots and RCPs/SSPs.

As a general advice, scenarios should not be too detailed or extensive as this may constrain rather than facilitate discussions (5-10 sentences normally suffice).

8 AAL stands for Average Annual Losses is a loss statistic that is widely used in disaster risk assessments. It accounts both for the probabilities of certain scenarios and their potential effects in terms of monetary losses and expresses the expected loss per year, averaged over many years.

Scenarios need to cover issues that are decisive for the consequences and management of the scenario. Hence, consequences that are to be assessed, according to the scenario, i.e., losses to life and health, housing, livelihoods, property, environment, and cultural heritage, should obviously not be integrated into the scenario. To give some input, one would expect information on:

- Hazard intensity/severity (e.g., magnitude, meter flood depth/flow velocity, storm surge height, wave height/speed, km/hour wind speed, rainfall volume/duration)
- Affected location/geographical area/assets
- Time (of the year, day of week, hour of the day)
- Climate and weather (wind speed and direction, temperature, precipitation, air humidity etc.)

The list above does not claim to be exhaustive, nor must all factors be included in the scenario. Factors that are deemed important depend on the hazard to be analysed. To allow for comparisons, all communities need to use the same scenarios as the basis for their assessments.

Although hazards are known to trigger each other (e.g., heavy precipitation or earthquakes may give rise to landslides, which in turn can create industrial accidents and so forth), it is recommended to refrain from using cascading hazard scenarios unless it is clear that these scenarios can occur in any of the communities that will be assessed and compared in terms of risk levels.

Trying to be comprehensive in the sense of identifying and assessing all possible ways that hazards may interact is very difficult, and perhaps unmanageable given limited time and knowledge. For these reasons, it is recommended to delimit the assessment by selecting "representative scenarios" for each of the hazards that are deemed prominent in a certain area.

Refer to Appendix 1 for the steps taken.

Community participation and validation

Communities share knowledge of past events, seasonal changes and warning signs. They help check whether hazard maps reflect their experience. Technical specialists explain projections and investigate differences between local accounts and available data.

BOX 3 - Roles and responsibilities

Lead and Supporting Agencies

2.1 Characterise/Quantify Hazards (Current Projection)

L: Min. of Public Works, Meteorological Services and Transport; Min. Rural and Maritime Development & Disaster Risk Management; Min. Lands and Mineral Resources

S: Min. iTaukei Affairs; iTaukei Affairs Board; DoCC; FBOS; UNOSAT; United Nations Office for Disaster Risk Reduction (UNDRR); Platform on Disaster Displacement (PDD); Department of Environment; IDMC; Min of Health and Medical Services; World Meteorological Organisation (WMO), SPREP, SPC, USP

2.2 Characterize/Quantify Hazards (Future Projection)

L: Fiji Meteorological Services; Min. Lands and Mineral Resources; DoCC

S: National Disaster Management Office (NDMO), SPC; USP; FNU; IDMC

2.3 Create Hazard Specific Scenarios

L: Min. of Public Works, Meteorological Services and Transport; Min. Rural and Maritime Development & Disaster Risk Management; Min. Lands and Mineral Resources

S: Min. iTaukei Affairs; iTaukei Affairs Board; DoCC; FBOS; UNOSAT; UNDRR; PDD; Department of Environment; IDMC, SPC, other partners in NDMO cluster

Output

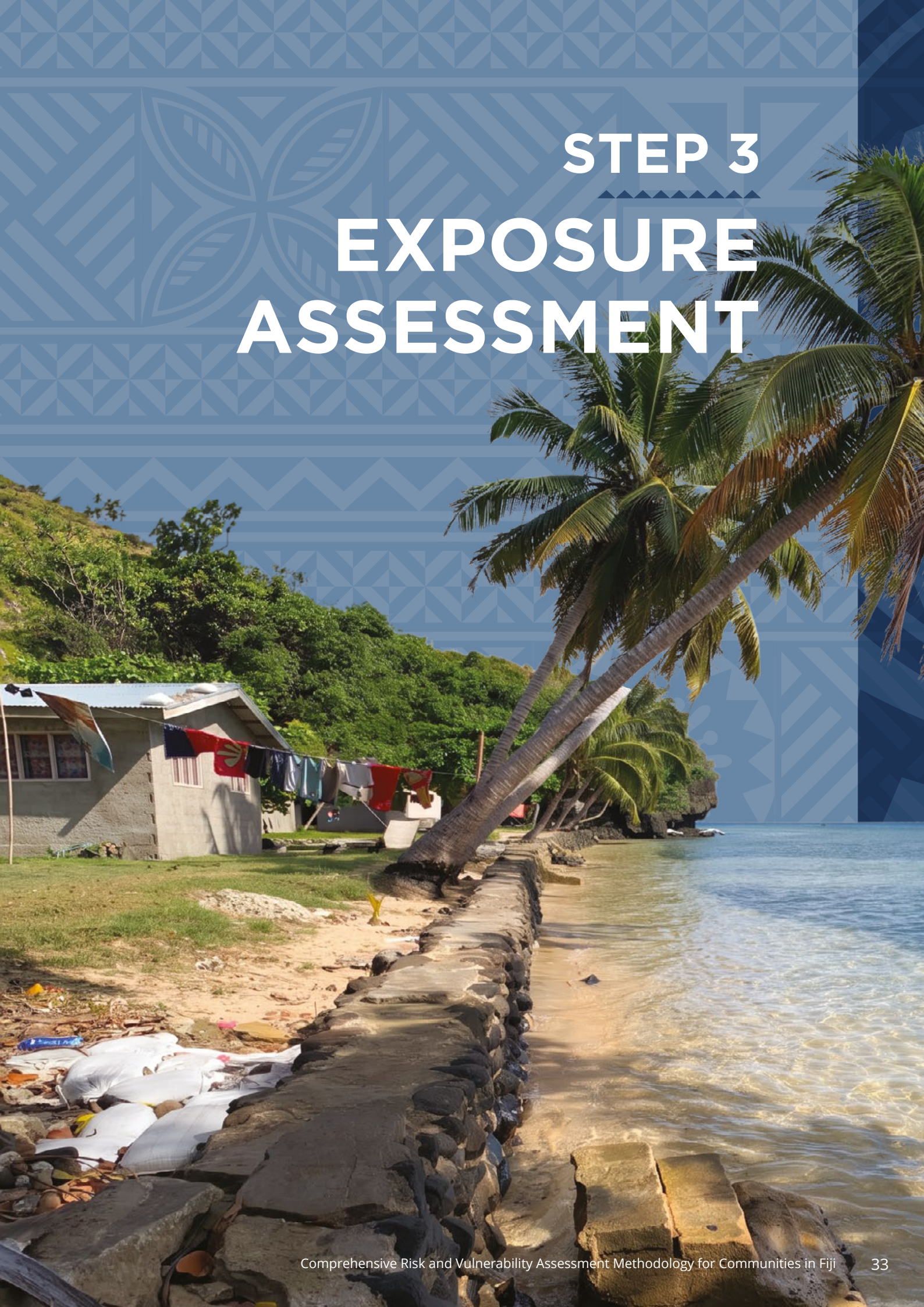
A detailed assessment report with relevant hazard maps on present hazards, future projections and hazard-specific scenarios.

Link to the next step

Step 3 overlays the hazard information with Step 1 inventory to determine who and what is exposed. The same scenarios and likelihood information inform vulnerability interpretation in Step 4 and risk assessment in Step 5

STEP 3

EXPOSURE ASSESSMENT



STEP 3 – EXPOSURE ASSESSMENT

Purpose

Even though step 2 to some extent includes an assessment of exposure (since this guide only focuses on hazards that are prominent in Fiji), this step represents a more in-depth scrutiny of the exposure of the identified communities. A team of in-country experts is deployed to:

- Identify and assess the effects of existing and potential natural and man-made (structural) barriers, and assess how they may reduce the exposure to the forces posed by natural hazards (Step 3.1);
- Use Geographic Information Systems (GIS) and asset categories developed in Step 1, it is possible to calculate, compare and visualise the degree of exposure to respective hazards (Step 3.2).

Link to SOP

This CRVAM step supports SOP steps 7 and 8 of phase C (chapter 4.3. Preliminary screening, scoping, initial risk assessment) and SOP step 11 of phase D (chapter 5. Pre-stage II: Detailed assessment & planning).

Table 3. Natural vs Human Induced Hazards

Natural Hazards	Human Induced Hazards
Storm Surges	Ocean Warming (Coral Bleaching)
Volcanic Activity	Ocean Acidification
Tsunamis	Coastal Inundation
Wind/storms (including cyclones)	Fires
Tornadoes	
Earthquakes	
Droughts	
Landslides	
Riverine Floods	
Flash Floods	
Coastal Floods	
Coastal Erosion	
Riverbank Erosion	

Hazards may have different spatial extents depending on their type and severity/return period. For some hazards, the exact location of an asset is important (e.g., landslides, inundation from storm surges, rain induced floods, tsunamis). For others, this is less significant (e.g., wind/storm and droughts). Locations are to be determined as precise as possible to be able to calculate expected damages for the first types of hazards.

As much as possible, these hazards should be handled and displayed as layers in a GIS normally as a set of layers representing different return periods. Overlaying such hazard maps with map layers of assets (identified through Step 1.2) will signify how exposed these assets are to the respective hazards[9]. All assets within the extent of the hazard area are regarded to be exposed and therefore subject to possible damages or losses.

As exposure is hazard-specific, one needs to consider the presence of factors that affect exposure for each of the hazards included in the assessment, where e.g., topography is essential for storm surges and floods while slope and soil are important for landslides and erosion (see Figure 3). In addition, there may be both man-made structures (e.g., sea walls) and natural barriers (e.g., trees, mangroves, hills) that help to offset or divert forces of natural hazards and thereby reduce the communities' degree of exposure to these.

Figure 3: Vuniniudrovu riverbank collapse



9 It is presumed that the technical experts who are tasked to implement this methodology, either know how to perform such overlay analyses or can be supported by in-country GIS experts (alternatively UNOSAT) to do so.

Inputs required

- Asset and population inventory from Step 1 and hazard maps and scenarios from Step 2.
- Obtain sufficiently detailed location data, imagery, community boundaries and information on existing protective measures. Use technical advice and the adaptation assessment template in Appendix 2 where relevant

Assessment activities

STEP 3.1 – Assess current and potential nature-based and structural adaptation measures

To identify and assess the effects of existing and potential nature-based and structural adaptation measures, it is suggested to conduct "adaptation studies" of the communities. These need to be carried out by a team of government agency experts and supporting experts with a good knowledge on nature-based and structural adaptation options with respect to the focal hazards[10]. The assessment team should write a short report (1-2 pages) for each of the communities comprising:

- what kind of adaptation options (nature-based or structural) already exist or could be erected (if any)
- what effects they are deemed to have (e.g., in terms of reduced areas for floods or physical damages on structures) and how/why these positive effects would come about, i.e., motivating/clarifying the measures to decisionmakers by explaining the "generative mechanisms" involved (why A leads to B)
- how long the measures would take to implement (or to become effective)
- a rough estimate of the cost for their implementation.
- Traditional Ecological Knowledge on adaptation options that could be leveraged

STEP 3.2 – Visualise exposure

Appendix 2 has the detailed steps on assessing adaptation options.

The outputs of the adaptation studies should inform the GIS exposure mapping so that the potential area of exposure is less in cases of communities that have existing barriers than those that do not.

Ideally, the effects of potential barriers (in terms of reduced area of exposure) could similarly be visualized with GIS, which could facilitate discussions and decisions about possible adaptation measures.

10 The IPCC (2014) WGII AR5 enacted a comprehensive list of adaptation measures (see table on page 845 of this document: https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap14_FINAL.pdf).
For adaptation solutions specific to communities on rural islands, see IPCC (2022b) WGII AR6 Cross Chapter Paper on Settlements by the Sea: https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_CCP2.pdf

The overlay of exposure and asset layers enables an assessment of the exposure of communities (in terms of the ratio of assets or their geographic area) from a scale of 1-5 as described in Table 4:

Table 4. Levels and indicators for assessing exposure.

Score	% of assets (or geographic area) exposed
5 - Very high	>75%
4 - High	50-75%
3 - Medium	25-50%
2 - Low	5-25%
1 - Very Low	≤5%

Such exposure mapping would enable a ranking of communities regarding their exposure to different types of hazards and inform the risk calculations in Step 5.

The levels use data from hazard maps, remote sensing, economic and demographic data and asset registers to determine overall ranking of a community.

A score of 5 means that >75% of assets, which could be material or living, are exposed to the hazard. Physical or material assets include houses, infrastructure (bridges, drains, buildings, sewer lines), roads and critical facilities.

A score of 4 means that 50-75% of assets are exposed to the hazard while a score of 3 means that between 25-50% of the assets are exposed to the hazard.

Geographic area exposure is the area of land (% or in km^2) exposed to the projected hazard(s). The area could include, for example, culturally significant resources and sites and/or important biodiversity areas.

NOTE: This exposure mapping will be repeated for potential relocation sites that have been identified through Step 7 and SOPs. Relocation should only be undertaken if a prospective site is significantly less exposed to hazards for the projected time period than the community's present location. Importantly, direct comparisons only apply if the current and prospective community locations are similar in terms of geographic and population size, number, type, and vulnerability of assets at risk. To simplify the assessment and avoid integrating large uncertainties about the state of the future, one may assume that these elements are static. Hence, differences in terms of exposure are related to topography, geology, and vegetation as well as existing and potential structural and nature-based barriers in the areas concerned. Figure 4a shows a GIS map of Vuniniudrovu and the average annual losses of buildings and Figure 4b is a GIS map showing the average annual loss of buildings in Nadagoloa.

Figure 4a: Average Annual Losses of Buildings - Vuniniudrovu

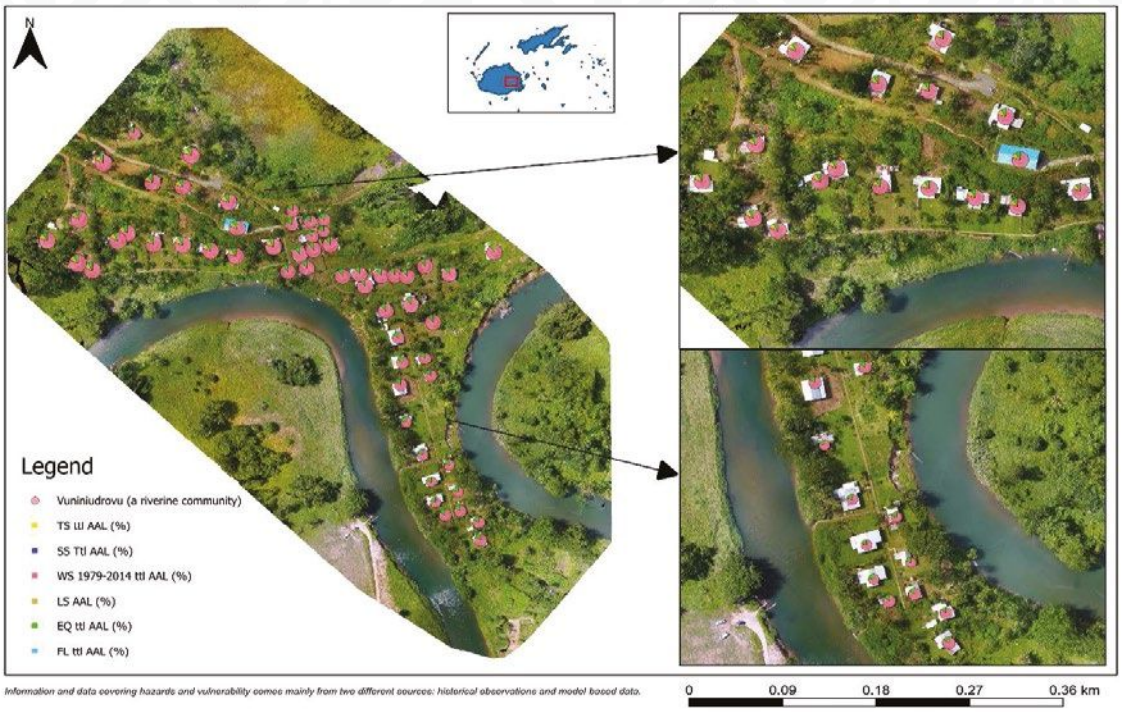
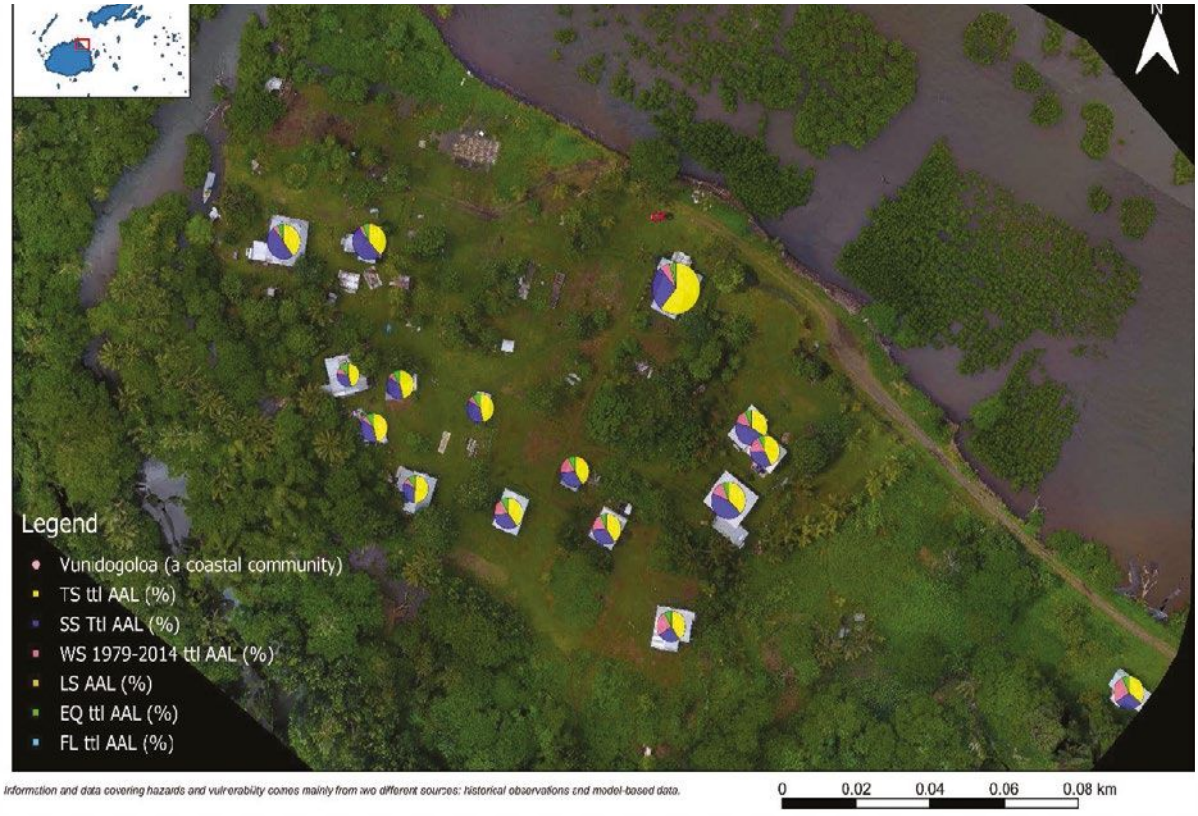


Figure 4b: *Average Annual Losses of Buildings - Nadogoloa*



Community participation and validation

Communities help locate who and what is in harm's way. They check locations of homes, water sources, gardens, infrastructure and cultural sites, and identify existing protective measures.

BOX 4 - Roles and responsibilities

Lead (L) and Supporting (S) Agencies

3.1 Identify/Characterize Current & Potential Nature-based & Structural Barriers

L: Min. of Public Works, Meteorological Services and Transport; Hydrographic Office (Fiji Navy - reefs); Min. Agriculture and Water Ways (planted barriers; NB seawalls, boulders Min. iTaukei Affairs; iTaukei Affairs Board; Min. Rural and Maritime Development & Disaster Risk Management; Min. Lands & Minerals Resources Department (mangroves); Fisheries (reefs) and Forestry (trees and mangroves); FRA (roadside slips/ landslides/gabion baskets)

S: NDMO, SPC; USP; FNU; UNOSAT; CCD; FBOS, MECC (Dept of Environment), IUCN, Conservation International, GGGI, GIZ

3.2 Quantify/Visualize Exposure

L: NDMO; Met; CCD; Fisheries (reefs), Forestry, MLMR (Foreshore, MRD, and GIM (geographical info management)

S: UNOSAT, USP, SPC, SPREP, SPC

Output

The main output of Step 3 is GIS maps with overlays of hazards, exposure and assets.

Link to the next step

Step 4 assesses the vulnerability and coping capacities of exposed people and the susceptibility of exposed assets to damage. Step 5 uses the exposure results to estimate consequences. Step 6 appraises the potential measures recorded in Step 3.1.

STEP 4
ASSESS VULNERABILITY



STEP 4 – ASSESS VULNERABILITY

Purpose

After identifying hazards and determining exposure – which are important but insufficient bases for risk analyses that seek to define the consequences and likelihood of hazardous events—this step is to aggregate information about the vulnerability of the people and assets one wants to protect. The vulnerability assessment comprises two parts:

- Mapping the socio-economic vulnerability and coping capacities of communities denoted "human vulnerability" in the flowchart (Step 4.1); and
- Assessing and quanifying the vulnerability of physical structures (Step 4.2)

The first of these activities helps in understanding community profiles and context, which facilitates decisions on where communities potentially could relocate. Vulnerability is composed of physical vulnerability (sensitivity/fragility of physical assets), and the vulnerability/lack of coping capacity on all or parts of community members.

Link to the SOP

This CRVAM step supports SOP steps 7 and 8 of phase C (chapter 4.3. Preliminary screening, scoping, initial risk assessment, Section III, Page 25, 26) and SOP step 11 of phase D (chapter 5. Pre-stage II: Detailed assessment & planning, Section III, Page 32).

Inputs required

- Use the community profile and asset inventory from Step 1
- Hazard characteristics from Step 2
- Exposure findings from Step 3

Assessment activities

STEP 4.1 – Characterise human vulnerability

While the determination of physical vulnerability is straightforward (described in Step 4.2), the concept of human vulnerability and lack of coping capacity is less well defined. There are no direct indicators for the vulnerability/lack of coping capacity, and socio-economic proxy indicators are often used to characterize and quantify this type of vulnerability.

Whilst developing the CRVAM, an extensive set of scientific studies were scrutinized to extract indicators that are most frequently used as part of socio-vulnerability indices. These indicators are the backbone of an electronic survey that has been put together in support of community consultations (Appendix 3 motivates the selection of indicators, i.e., what they are supposed to indicate and the scientific basis for this).

The structure of this survey is aligned with INFORM, which is a global risk index developed in 2012 by the Inter-Agency Standing Committee (IASC) and the Joint Research Centre (JRC) at the European Commission.[11] INFORM has already been used to enact a profile for Fiji at national and district levels[12], but not yet been applied on community level (where the CRVAM could help by filling this gap and enhance the congruence between assessments on disaster risk across different administrative levels in Fiji). Akin to the INFORM, the CRVAM has structured the indicators along the following three "themes"[13]:

- Hazards & exposure (events that could occur and exposure to them)
- Vulnerability (the susceptibility of communities to those hazards)
- Lack of coping capacity (lack of resources available that can alleviate the impact)

Each question in the survey consists of an indicator with five response alternatives, which reflect different degrees to which the specific indicator is fulfilled. This allows for the calculation of a total average value (across various sub-categories) between 1-5, indicating the vulnerability of a certain community as well as the possibility of comparing and ranking communities in this regard (similar to how the outputs of INFORM has been presented by help of radar graphs). In addition to fixed response alternatives, the survey also comprises free-text questions on what the communities have done, and might do, to reduce exposure and increase their coping capacities vis-à-vis the hazards they face.

For the vulnerability assessment to be effective and valid, the survey should be answered by a group of people that represent various sub-groups of the community, including women, men, girls, boys, elderly and persons with disabilities[14]. Refer to the SOP for guidance to ensure participation of all groups and the free, prior, informed consent approach (Section II - 1 - 6).

STEP 4.2 – Characterise physical vulnerability

The physical vulnerability of assets depends on their structure/material and the specific dangerous features of a hazard. For each category of assets (compare Step 1.2), the impact of the natural hazards included in the assessment looks different. Impacts are calculated or estimated by considering the intensity of a hazard as well as the vulnerability and monetary value of exposed assets.

Data are sourced from community-based interviews or photos; Post Disaster Needs Assessments (Post-Disaster Needs Assessment Fiji) scientific publications or other records. The impact of a hazard on an asset is usually described with a vulnerability curve displaying the degree of damages depending on the magnitude of the hazard (see Fig. 5).

11 Information about INFORM can be found at: https://drmkc.jrc.ec.europa.eu/inform-index

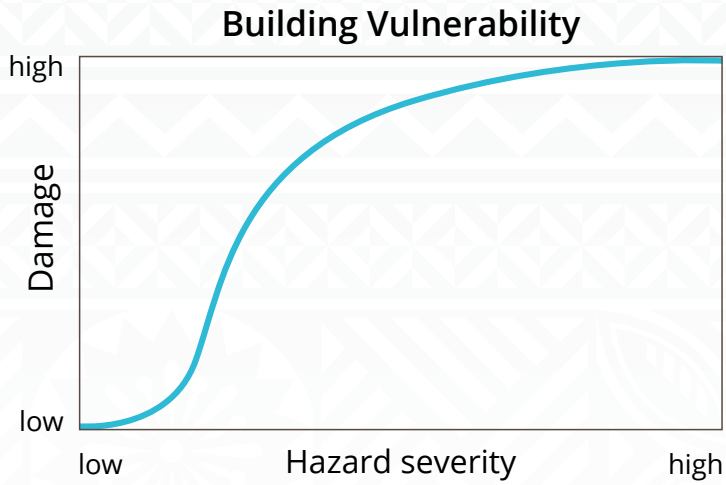
12 The INFORM profile for Fiji is published on JRC's homepage: https://drmkc.jrc.ec.europa.eu/inform- index/INFORM-Risk/Country-Risk-Profile whereas profiles on district level in Fiji can be seen here: https://unosat- geodrr.cern.ch/dss/FJI/Diagnostic/

13 To the extent possible, the CRVAM has also aligned the indicators with the sub-categories INFORM uses for each of these themes.

14 Other aspects worth considering include different livelihood profiles, socio-economic levels, and dependency on, or attachment to, land or local resources and opportunities (Ferris, 2017)

The community survey also comprises questions about the location, number, material, and replacement value of physical objects, which supports damage calculations and assessment of physical vulnerability.

Figure 5: Illustration of a generic vulnerability curve



NOTE: Vulnerability curves have a sigmoid type of character (stretched S-shaped curve). Very low intensities of hazards do not harm an asset, but with growing severity, damages are quickly increasing as structures start disintegrating. Once a structure is reduced to rubble or small parts, a strong increase of the external force is needed to result in more damages.

Examples of physical vulnerability include those living in informal and peri urban settlements where houses are not built for withstanding cyclonic winds. Those physical structures with weak roofs and foundations. Coastal and riverbank villages that are prone to flooding. Wooden bridges collapsing from lack of maintenance and upgrading. Roads being washed away and damaged by landslides. On other vulnerabilities refer to NELD Step 6.8.

$$\text{Vulnerability} = \frac{\text{Exposure} + \text{Sensitivity}}{\text{Adaptive Capacity}}$$

(IPCC methodology 2007)

Community participation and validation

Communities explain why some people or assets may suffer greater harm, and what helps them cope. This includes mobility difficulties, access to warnings and services, housing conditions, local knowledge and support networks. Different groups may have different experiences.

BOX 5 - Roles and responsibilities

Lead (L) and Supporting (S) Agencies

4.1 Human vulnerability / Social

L: Min. iTaukei Affairs; iTaukei Affairs Board; Min. Rural and Maritime Development & Disaster Risk Management (National Disaster Management Office); Department of Climate Change; Min. Women, Children and Social Protection; Min. Multi-Ethnic Affairs and Sugar Industry; Min. Youth, Min Health and Medical Services, Min Housing

S: Most NGOs, CBOs, FBOs involved in social vulnerability – do not have level of capacity (assessment)

4.2 Physical vulnerability (separate into built and natural)

L: Min. of Public Works, Meteorological Services and Transport Min of Lands and Mineral Resources (Foreshore, MRD, and GIM (geographical info management); Min of Forestry; iTaukei Affairs Board Conservation Unit; Min of iTaukei Affairs, Min of Education, Heritage and Arts., Min of Agriculture & Waterways, Fiji Roads Authority, Fisheries

S: UNOSAT, USP, SPC, SPREP, GGGI, GIZ, Academic institutions

Output

The outputs of Step 4 are completed electronic survey forms assessing human vulnerability/lack of coping capacity using KOBO toolbox and vulnerability curves showing physical vulnerability.

Link to the next step

Step 5 combines these findings with the hazard and exposure evidence to assess consequences and risk.

STEP 5

CALCULATE AND EVALUATE RISKS



STEP 5 – CALCULATE AND EVALUATE RISKS

Purpose

To assess present and future risk to communities by combining information on hazards, exposure and vulnerability.

The assessment considers potential consequences across seven categories: life and health, housing, displacement, livelihoods, property (financial worth of physical assets), the environment and cultural heritage.

Link to SOP

This CRVAM step supports SOP step 11 of phase D (chapter 5. Pre-stage II: Detailed assessment & planning Section III, Page 32 using Kobo Toolbox.)

Inputs required

Step 5 draws on the findings from Steps 1 - 4 and supporting evidence to assess consequences and calculate risk.

Assessment activities

Applying the rating scales and risk matrix

Having gathered the required information on hazards, exposure and vulnerability for the focal communities, their risk can now be assessed. The likelihood and consequences will be assessed using 5-graded scales and presented by the help of a risk matrix (Table 5). It is suggested that consequences will be assessed according to seven different dimensions (see Table 7):

- lives/health
- housing
- displacement
- livelihoods
- property (financial worth of physical assets)
- environment
- cultural heritage

Risk = Hazard x Exposure or Likelihood/Capacity

A mix of quantitative and qualitative methods are used to assess this varied nature of consequence dimensions[15] (how this is done is further explained in Appendix 1). Based on the hazard scenarios developed in Step 2.3, each consequence dimension will be given a numeric value between 1-5, where 1 represents the least serious consequence for each type of dimension.

An average value for all consequence dimensions is then multiplied with an assessment of likelihood. These risk levels could be combined with recommendations on the urgency of risk reducing measures where, e.g., green could indicate that no action is required and red that urgent risk reduction or relocation is needed. This is part of risk evaluation and subject to the discretion of communities and decision-making bodies as in the SOPs.

Table 5. Example of a risk matrix[16]

		Likelihood				
		Very Low (1)	Low (2)	Medium (3)	High (4)	Very high (5)
Consequences	Very High (5)	5	10	15	20	25
	High (4)	4	8	12	16	20
	Medium (3)	3	6	9	12	15
	Low (2)	2	4	6	8	10
	Very Low (1)	1	2	3	4	5

RISK LEVELS

Very Low 1	Low 2-4	Medium 5-10	High 12-16	Very High 20-25

The resulting risk scores range from 1 (lowest risk) to 25 (highest risk) and are visualized by the help of a colour-coded risk matrix. A risk score is thus obtained from assessing each hazard scenario. A total, multi-hazard, score can then be derived from calculating an average value for all assessed scenarios, making it easy to compare the current and future[17] risk levels of various communities.

15 *Quantitative* methods use mathematical operations, analytical models, and empirical data for assessing risk. This implies using frequencies (i.e., the number of events per unit of time) or likelihood (the possibility of one event in a given time frame) for estimating the occurrences of hazardous events and expressing their potential consequences in numeric estimates (e.g., numbers, volumes, areas). *Qualitative* techniques on the other hand, rest upon judgments of experts, who often describe risks with the help of words and ordinal/sequential scales (e.g., low-medium-high). Semi-quantitative scales may also be used where each step in ordinal scales is combined with a numeric interval indicating the likelihood or magnitude of consequences (e.g., once every 10 to 100 years, or 5–10 casualties). Although quantitative assessments are more precise, they require a fair amount of loss data to ensure they render valid results. Consequently, expert judgements may sometimes be the sole option when assessing disaster risk, which involve infrequent hazardous events (Månsson et al., 2017).

16 Due to limited space, a simplified risk matrix is used here for illustrative purposes. Appendix 5 displays the risk matrix supporting the CRVAM.

17 Future risks depend on the selection of time slots for change projections.

Only the most prominent hazards at each location should be assessed, which means that not all hazard types will be assessed for all communities (assessing the risk of storm surges, for instance, is not relevant to communities outside areas of potentially affected by storm surge). The multi-hazard scores are still comparable given that they are based on mean values of the number of scenarios assessed. Table 6 can then be enacted to facilitate such comparisons:

Table 6. Illustrations of the presentation of risk scores

Community	Storm		Drought		Flood		Average (multi-hazard) risk score	
	Current	Future	Current	Future	Current	Future	Current	Future
A	6	8	4	5	6	7	4,3	5,3
B	5	6	3	5	5	8	4,3	6,3
C	2	3	4	5	3	4	3	4
...								

To compare disaster risks in different communities, it is necessary to estimate or, if possible, calculate risk in quantitative terms.[18] Accordingly, the CRVAM uses likelihood (the possibility of one event in a given time frame) for estimations about the occurrences of hazardous events as well as semi-quantitative scales for assessing consequences where expressions like “High” and “Low” are adjoined with numeric intervals.

Cost-benefit analyses of potential risk reducing measures are simpler if losses and damages are expressed in economic terms. For physical objects, this is quite straightforward. Assessing the potential losses in lives, livelihoods and the environment could be done through coupling data from qualitative group discussions and empirical data. When assessing physical damages, however, models have been developed that allow quantitative calculations and financial estimates of the direct effects of hazardous events. Before explaining how such models work, it is important to address the notions of primary and secondary impacts as well as temporal aspects when assessing disaster risks. Alternative approaches to assessing secondary impacts, that include both economic and non-economic loss and damage, are included in Box 6.

There are also, however, important non-economic losses and damage (NELD) where assigning economic values is difficult, such as lives, environmental and cultural heritage assets. To the extent possible, these dimensions have nevertheless been coupled with quantitative estimates.

18 Studies (Lane, 2008; Månsson et al., 2017; Restrepo, 1995; Ruth, 1982) have shown that quantitative assessments facilitate comparisons across risk assessors and geographic areas, wherefore CRVAM proposes using quantitative estimates whenever feasible (e.g., for estimating the value of assets, effects of consequences and cost of risk reducing measures).

BOX 6 on Approaches to assess Non-Economic Loss and Damage

Another, parallel, way of conceptualizing these primary and secondary hazard impacts is economic and non-economic losses and damages (NELD). Some actors convert NELD into quantifiable terms, e.g. by comparing it to other forms of harm, including economic ones, under the umbrella of holistic 'total economic value'. A key UN technical paper in 2012 reviewed several 'quasi-economic' approaches: economic valuation, multi-criteria decision analysis, risk indices, and semi-quantitative assessments. Economic valuation may include 'willingness to pay' questionnaires to gauge the hypothetical value of non-economic losses. This technique has attracted some criticism since lower-income communities will have fewer financial resources available and will, therefore, typically state that they are willing to pay less to rectify NELD than higher-income peers.

Others question these quasi-economic approaches on grounds of methodology, philosophy and usefulness for real-world policy design. Instead, contrasting voices propose qualitative, descriptive, rights- and power-based frameworks. These alternative approaches purport to understand NELD beyond financial compensation to support strategic planning for and responses to NELD. They promote consultation with affected communities to identify and evaluate loss and damage in non-quantitative terms.

Different ways of understanding NELD diverge on several questions, including adoption of qualitative versus quantitative frameworks; different non-economic value systems; and the extent to which they promote 'bottom-up', consultative evaluation techniques. Qualitative descriptions of NELD are useful to grasp community needs in advance planning and in navigating disaster response. However, for the purposes of this CRVAM, it may be necessary to adopt primarily quantifiable frameworks. Evaluation also needs to be highly tailored to local contexts, given the diversity of local impacts.

Adapted from: https://www.lse.ac.uk/granthaminstitute/explainers/what-is-non-economic-loss-and-damage-neld/

For further guidance: Technical paper from UNFCCC: https://unfccc.int/resource/docs/2013/tp/02.pdf (see page 34)

The magnitude of these consequences needs to be assessed by a technical working group based on the scenarios that have been developed in Step 2.3. These individuals should have knowledge on the characteristics of the hazard type as well as community in focus. Importantly, the magnitude of consequences is directly linked to the hazard intensity (as defined by the scenario) as well as the exposure and vulnerability of the focal community.

As each of these elements have been assessed already (through Steps 3 and 4), these assessments should be referred to and considered when appraising consequences as well. How assessments of consequences and likelihood are transferred into risk scores have already been described.

STEP 5.1 – Primary and secondary impacts

Consequences of disasters can be divided into primary and secondary impacts (also called direct and indirect effects [or losses]). **Primary impacts** include all losses that occur during, or within the first few hours after the disaster, as a direct result of the hazardous event. These losses occur in the disaster area and are typically tangible and quantifiable, such as the number of people killed, number of people displaced and the damage to buildings, infrastructure, and natural resources. **Secondary impacts**, on the other hand, occur as an effect of a knock-on effect of the primary impacts.

Damaged infrastructure and transportation systems, for instance, may cause disruptions to the flow of goods and services, which in turn may lead to declines in revenues and affect the wellbeing of people (e.g., caused by the lack of medications, post-traumatic stress or unemployment). Displacement can cause serious mental health harm, as well as loss of land, home, sense of purpose, place and community identity. It can also cause marginalization and disproportionate impacts on some members of the community. Wider impacts include longer-terms social and economic effects, for example in education, health, productivity or in the macro economy (e.g., price increases, increases in government debt, negative impact on stock market prices, and decline in GDP). Secondary losses can occur inside or outside of the hazard area and often with a time lag (cf. “economic loss” in UNDRR, 2020).

Evidence shows that secondary impacts often surpass primary impacts (GFDRR, 2014) and, hence, are important to consider. Reliable methodologies to assess them (incl. understanding and modelling dependencies and potential cascading effects between vital societal functions) are lacking. The CRVAM focuses on primary and secondary impacts.



STEP 5.2 – Cut-off times for attributing consequences

The definition of primary impacts given above stipulates that these effects need to arise "within the first few hours after the disaster". In sudden-onset disasters (e.g., earthquakes, floods, storms) where most damages and losses occur close to the time of the initial onset of the event, such assessments are relatively unproblematic. It is more challenging with slow onset disasters (e.g., droughts, epidemics) or undesired slow developments related to climate change (e.g., soil degradation, crop yield reduction, ocean acidification, salinization, or invasive species), where their full effects may take weeks or months (sometimes even years and decades) to materialize. This challenge has also been observed in relation to the Sendai framework reporting requirements, where states have been urged to stipulate their own cut-off times according to their own data collection objectives (UNDRR, 2017, p. 10-12). Yet, UNDRR proposes time frames for some hazards, including droughts (6 months after emergency state ceases); floods and earthquakes (4 weeks after event) and epidemics (when no new cases are reported).

Regarding assessment with the CRVAM, it is proposed that the key ministries responsible for developing the hazards scenarios (Step 3.2) also stipulate timeframes by which consequences should be assessed. Although the cut-off time should be reasonable relative to the hazard scenario, its accuracy is of secondary importance. Of greater importance is that the same cut-off times are applied during assessments of all communities, so that the outputs of these assessments are comparable. Regardless of cut-off times, it is advised to only incorporate primary impacts, i.e., effects that are directly attributable to the hazardous event (i.e., not arise as an effect of secondary impacts). In this regard, it is also advised that the Ministries in charge of creating scenarios seek to stipulate and communicate to the risk assessors and the communities, the types of losses that should be considered as primary and secondary impacts.

Table 7. CRVAM Risk Matrix

Risk Score = Average value for all consequences dimensions* Assessment of Likelihood

	CONSEQUENCES				
	Life/health	**Houses**	**Displacement**	**Livelihoods (LH)**	**Property (x 1,000 FJD)**
Very High (5)	> 5 fatalities and/or >10 seriously injured/ill Severe trauma >25% Under immediate threat - within 2 years people's lives are in danger	>75% of pop with destroyed houses (housing units)	>75% of pop displaced, and/ or for an extreme duration (>6 months)	>75% of pop with disrupted / destroyed LH	>50,000
High (4)	3-5 fatalities and/or 5-10 seriously injured/ill Severe trauma 10 - 25% Under threat - within 5 years people's lives are in danger	50-75% of pop with destroyed houses (housing units)	50-75% of pop displaced, and/or for duration of 1 to 6 months	50-75% of pop with disrupted / destroyed LH	25,000-50,000
Medium (3)	1-2 fatalities and/or 1-4 seriously injured (hospitalisation, life threatening /ill Moderate 5 - 10% Under threat - within 10 years people's lives are in danger	25-50% of pop with destroyed houses (housing units)	25-50% of pop displaced, and/or for a duration of 1 week to 1 month	25-50% of pop with disrupted / destroyed LH	10,000-15,000
Low (2)	3-5 slightly injured/ill Mild trauma ≤5% Under threat - within 30 years people's lives are in danger	5-25% of pop with destroyed houses (housing units)	5-25% of pop displaced, and/or for a duration of 2 days to 1 week	5-25% of pop with disrupted / destroyed LH	>10,00-1,000
Very Low (1)	1-2 slightly injured (can be treated at home or village nurse) OR ill (water-borne; flu; dengue; typhoid, malaria) 0% (considering severity of trauma) Under threat - 70+ years people's lives are in danger	≤5% of pop with destroyed houses (housing units)	<5% of pop displaced, and/or for a duration of less than 2 days	≤ 5% of pop with disrupted / destroyed LH	≤ 1000

		LIKELIHOOD				
Environment	**Cultural Heritage**	**Very Low (1) (>100 Yrs)**	**Low (2) (>50-100 Yrs)**	**Medium (3) (>30-50 Yrs)**	**High (4) (>10-30 Yrs)**	**Very High (5) (≤10 Yrs)**
>50% of geographic area affected, long recovery (with or without human intervention) (>50 yrs)	>50% significant loss of tangible and intangible cultural heritage	5	10	15	20	25
30-50% of geographic area affected, medium recovery (with or without human intervention) (10-50 yrs)	30-50% loss of tangible and intangible cultural heritage	4	8	12	16	20
10-30% of geographic area affected, medium recovery with or without human intervention) (10-50 yrs)	10-30% loss of tangible and intangible cultural heritage		6	9	12	15
5-10% of geographic area affected, quick recovery (<10 yrs with or without human intervention)	5-10% loss of tangible and intangible cultural heritage	2	4	6	8	10
≤5% of geographic area affected, quick recovery (<10 yrs with or without human intervention)	<5% loss of tangible and intangible cultural heritage	1	2	3	4	5

STEP 5.3 – Assess loss of life and health impacts

This dimension assesses the number of people who die or experience physical injuries, illness or psychological harm19, as a direct result of a hazardous event, either during the disaster or in its aftermath. The assessment distinguishes between serious and minor injuries or illnesses. Serious cases are those requiring hospitalisation, while minor cases require no more than first-aid treatment.

With regards to fatalities, the Integrated Research on Disaster Risk (IRDR, 2015, p. 9-11) differentiates between direct deaths, indirect immediate deaths and indirect delayed deaths20. Direct deaths embrace persons who die as a direct result of a disaster (e.g., buried or struck by debris during a storm, landslide, or earthquake, or drowned in a flood or storm surge). Indirect immediate deaths include persons who die of other causes than the force or energy of the hazard but that only dies because the disaster happened. This embraces e.g., heart attacks from constructing flood barriers or clearing rubble, or traffic accidents during evacuations. Indirect delayed deaths are caused by longer- term effects of a disaster and only visible and measurable well after the disaster happened (years to decades). This includes, for instance, radioactive exposures after a nuclear power-plant meltdown or deterioration of health due to food shortage occurring after several years of drought/famine or cardiovascular and respiratory diseases from the smoke and particulates released during wildfires.

Figures about delayed deaths from disasters are less often reported in loss data statistics and also assumed to represent a small minority of cases and hence not affect the statistical strength (UNDRR, 2017, p. 10). Again, connected with a decision on cut-off times, authorities need to determine whether to include indirect delayed effects on people's life and health. However, it is not recommended given that it introduces large uncertainties and only involves a few persons of the total population affected from disasters anyhow. Hence, it is proposed to only incorporate direct and indirect immediate deaths into the assessments.

The assessment of the dimension Life & Health is based on the following values in Table 8:

Table 8. Levels and indicators for assessing losses to Life & health.

Score	Life/health
5 (very high)	>5 fatalities and/or >10 seriously injured/ill
4 (high)	3-5 fatalities and/or 5-10 seriously injured/ill
3 (medium)	1-2 fatalities and/or 1-4 seriously injured/ill
2 (low)	3-5 slightly injured/ill
1 (very low)	1-2 slightly injured/ill (future health for slow onset / safety and security)

19 Depending on the cut-off time for attributing consequences
20 The same reasoning as described for deaths could be applied for assessing the number of injured/ill.

STEP 5.4 – Assess displacement and housing losses

The dimension housing refers to the ratio of population whose houses (or housing units) are levelled, buried, collapsed, washed away or damaged to the extent that they are no longer habitable, and must be rebuilt. This means that one should not include houses (housing units) that are estimated to suffer minor damages, which may continue being lived in, although they may require some repair or cleaning.

The estimations of destroyed houses should ideally rely on damage curves (such as those described in Step 4.2) or at least be based on disaster loss and damage data from the same or a similar context with regards to housing types and hazard intensity. It is also important to take the exposure assessment into account, which reveals the relative exposure of different houses in the communities. Importantly, together with the assessment of the number of people that may lose their livelihoods (Step 5.5), the assessment of people that may lose their housing can be used for estimating displacement risk according to a methodology developed by the Internal Displacement Monitoring Centre (IDMC, 2022). Here, they use proxies in terms of average number of occupants per household of a country, which is a simple way of estimating the number of people that may lose their houses also when using the CRVAM.

The assessment of the dimension Housing is based on the following values in Table 9:

Table 9. Levels and indicators for assessing losses of housing.

Score	Housing
5 (very high)	>75% of pop with destroyed houses (housing units)
4 (high)	50-75% of pop with destroyed houses (housing units)
3 (medium)	25-50% of pop with destroyed houses (housing units)
2 (low)	5-25% of pop with destroyed houses (housing units)
1 (very low)	≤5% of pop with destroyed houses (housing units)

Score	Displacement
5 (very high)	>75% of pop displaced, and/or for an extreme duration (>6 months)
4 (high)	50-75% of pop displaced, and/or for duration of 1 to 6 months
3 (medium)	25-50% of pop displaced, and/or for a duration of 1 week to 1 month
2 (low)	5-25% of pop displaced, and/or for a duration of 2 days to 1 week
1 (very low)	<5% of pop displaced, and/or for a duration of less than 2 days

	Very Low	Low	Medium	High	Very High
Destroyed	0% destroyed	≤5% destroyed	5 – 10 % destroyed	10 – 50 % destroyed	>50% destroyed
Partially Damaged	<5% destroyed	5 – 24%	25 – 50 %	51 – 75 %	>75% destroyed
Intact Houses	>95%	61-94%	45 – 60 %	6 – 44%	<5%

STEP 5.5 – Assess livelihood losses

Livelihood losses may involve many things, e.g., damages to productive assets (both living and material) and disrupted activities required for securing a means of living, However, as the CRVAM also comprises an assessment of damages to property and environment, the assessment of losses to livelihood is confined to a calculation of the portion of people that may suffer from disrupted or destroyed livelihoods. This is also coherent with the reporting requirements of the Sendai framework, which facilitates the use of disaster loss statistics when assessing the risk of disasters.

Another important consideration is that some losses of livelihoods may be permanent whereas others are temporary and replaceable. UNDRR does not draw a line between the terms disrupted and destroyed (it only states that it is difficult to define the term disrupted, UNDRR, 2017, p. 29). Yet, the lack of indicators to separate these two concepts does not pose a problem for the reporting of loss data (or making risk assessments), since it is only required to convey the aggregated number of the two.

Disrupted or destroyed livelihoods should be assessed based on the exposure assessment carried out in Step 3.2. UNDRR suggests that assessing livelihood losses could be done by using average numbers of workers required per hectare of agricultural land, per livestock or per productive asset facility (e.g., industrial, commercial, services etc.). These numbers are then multiplied by the numbers of lost hectares of agricultural land, livestock or productive asset facilities destroyed (UNDRR, 2017, pp. 22, 25). A similar approach has recently been applied by the Internal Displacement Monitoring Centre when assessing the risk of displacement due to flooding in Fiji, where they derived the number of workers per sector (agriculture, services, and industry) from census data and the International Labour Organization (ILO) database (IDMC, 2022, pp. 23-25). However, if this approach is deemed too complicated, the assessments should be done through expert judgments, i.e., qualitative group discussions where the collective experience from previous disasters (preferably mixed with loss data) are used as bases for best "guesstimates". This qualitative group discussion-based approach may also allow for distinctions between permanent and temporary losses of livelihoods to be recognized.

The assessment of the dimension Livelihoods is based on the following values in Table 10:

Table 10. Levels and indicators for assessing losses of livelihoods.

Score	Livelihoods (LH)
5 (very high)	>75% of pop with disrupted/destroyed LH
4 (high)	50-75% of pop with disrupted/destroyed LH
3 (medium)	25-50% of pop with disrupted/destroyed LH
2 (low)	5-25% of pop with disrupted/destroyed LH
1 (very low)	≤5% of pop with disrupted/destroyed LH

STEP 5.6 – Assess environmental losses

Environmental losses embrace damages or degradation of air, water and soil, the destruction of ecosystems and the extinction of wildlife. It is defined as any change or disturbance to the environment perceived to be deleterious or undesirable (Johnson et al., 1997). The indicators in the CRVAM require the assessors to suggest the portion of the environment (air, water, soil) in the geographic area in focus (here the community) that may be damaged, but also the time it may take to restore the environment. Combining these two aspects (area/volume of damages and restoration time) allows for differentiating between events that may affect large geographic areas with temporary effects (e.g., contaminations of air or water) from more confined events but where damages to the environment may be irreversible or very difficult to restore (e.g., destruction of coral reefs).

The assessment of the dimension Environment is based on the following values in Table 11:

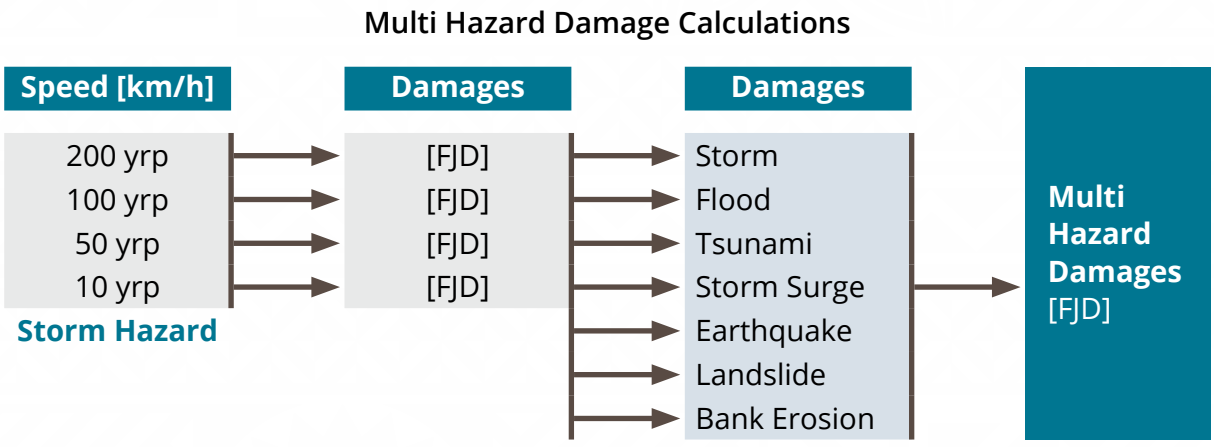
Table 11. Levels and indicators for assessing environmental losses.

Score	Environment
5 (very high)	>50% of geographic area affected, long restoration (>50 yrs)
4 (high)	30-50% of geographic area affected, medium restoration (10-50 yrs)
3 (medium)	10-30% of geographic area affected, medium restoration (10-50 yrs)
2 (low)	5-10% of geographic area affected, fast restoration (<10 yrs)
1 (very low)	≤5% of geographic area affected, fast restoration (<10 yrs)

STEP 5.7 – Assess property losses

For the risk dimension property or physical assets, impacts will be calculated on asset level (e.g., for each residential house) for all identified hazards and all available return periods of the respective hazards as well as a climate change scenario. The risk of disaster-related losses of assets are added for all hazards within a community and then aggregated for a total and an average value (based on households) of the community. Refer to Figure 6.

Figure 6: Illustration of the calculation of expected damages from multiple hazards



A small community may have a smaller total loss value than a much bigger community, but the average loss per household of a small settlement may be higher than that of a big village.

The agencies responsible for undertaking the calculations of the property losses for iTaukei Communities are the Ministry of Rural and Maritime Development and Disaster Risk Management and the iTaukei Affairs Board. For informal communities and settlements are the Ministry of Housing and Fiji Bureau of Statistics.

The assessment of the dimension Property is based on the following values in Table 12:

Table 12. Levels and indicators for assessing losses of property (in financial value)

Score	Property Value (FJD)
5 (very high)	>10,000
4 (high)	>5,000-10,000
3 (medium)	>1,000-5,000
2 (low)	500-1,000
1 (very low)	< 500

The risk data per individual asset are available too and may be considered especially when the risks of assets vary greatly. Assets with much higher risk values than other assets should be scrutinized and the urgency of reducing the risk determined separately from assets less at risk. In this context, it is recommended to consult the calculated Average Annual Loss (AAL) of high-risk assets. The AAL is a value reflecting the statistically expected yearly damages of an asset expressed as the percentage of the value of the asset.

If the value in Fiji Dollars is known, this may be translated to the corresponding monetary value. The AAL is calculated for typical physical assets (e.g., residential houses) as a multi-hazard value. For each hazard with different documented return periods, the expected losses are computed with vulnerability curves for each return period. The calculated damages are divided by the number of years of the respective return period, and the results are added to arrive at a total AAL per hazard. The totals from different hazards are added again to have a grand total AAL for a community. UNDRR provides a spreadsheet template for the calculation of damages, AALs and risk scores. The template allows the users to utilize hazard and exposure data imported from GIS and set various conditions like climate change associated modifications of sea level, wind speeds or floods. In this way, damage assessments can be done for the present time (Step 6.1) as well as for the future (Step 6.2). Calculated data may be exported to GIS for convenient access and display.

Another important consideration for property losses is that some buildings are not made of modern materials with high monetary value but are made of traditional materials with social and cultural value. This may be identified through group discussions with a community and accounted for in the cultural consequences column of the matrix through qualitative indicators.

STEP 5.8 – Assess Cultural Heritage Losses - Non Economic Loss

Non-economic loss and damage refers to the irreversible and invaluable impacts of climate change and disasters that are not easily quantified in monetary terms. This includes loss of life, human health, cultural heritage, traditional knowledge, biodiversity, and ecosystem services.

Fiji's Nationally Determined Contribution (NDC) 3.0 asserts that due to the deep interconnection between society and the natural environment, Fiji continues to be confronted with the ongoing challenge of restoring cultural heritage sites and continuing cultural practices and traditions in the current climate crisis.

Initial results of the cultural mapping exercise, conducted by the Ministry of iTaukei Affairs as part of the Fiji's obligations with ratification of the UNESCO 2003 Convention, revealed a large disparity in knowledge and skills between those in the 20-39yo age bracket and those 40+ years and older (Sevudredre, 2024).

Therefore, the scope of NEL Assessment in this section is for cultural values and specifically for its **restoration** and **continuity.**

For Cultural heritage, this NEL methodology aligns itself to the Fiji World Heritage Act 2024 (Fiji, 2024). Criteria in Section 2, that is used in assessing if a property is of outstanding universal value (OUV). Of relevance to the context of relocation is the criterion that states the property "be an outstanding example of a traditional human settlement, land use, or sea-use which is representative of a culture or cultures, or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change". The site from which the community has been displaced can be deemed OUV status and allows scope to identify and protect what communities value most. Fiji and other Pacific Island countries can use OUV as currency for Pacific cultural loss that is understood by development partners and international courts. This criterion is recognized in international frameworks such as the World Heritage Convention adopted by UNESCO in 1972, which "identifies, protects and preserves sites of international universal value, both cultural and natural, for all eternity".

In the development of the NEL methodology for cultural values in Fiji, there were five guiding principles:

i. Holistic approach
ii. Alignment to the CRVAM and existing risk frameworks
iii. Practical for Fiji Government field personnel
iv. Culturally appropriate (a cultural checklist has been developed as an appendix to the SOP to provide guidance) and
v. Stakeholder engagement and collaboration.

The conventional loss and damage assessment usually considers only those assets that can be traded on the market. Non-economic assets in Fiji that are both tangible and intangible are intertwined with the Vanua concept has four components:

i. **Spirituality** which includes belief in totems, spirits and traditional deities and the God of Christianity; they supplement each other although they try and supplant one another
ii. **Stewardship** of the natural environment.
iii. **Social bonds and kinship ties** which is the main currency of iTaukei life
iv. **Ways of being** which include beliefs, values and customs

Fiji committed to increasing national capacity to assess non-economic loss and damage, ensuring the ability to specifically understand potential damage and loss to cultural practices, traditional activities, cultural heritage sites, and traditional knowledge (cite NDC 3.0).

The CRVAM incorporates cultural heritage as a consequence dimension, recognizing. Percentage of geographic area of culturally significant resources and sites (e.g., temple, sacred grove, etc) affected is an incomplete measure but provides a starting point for comparisons. Since the value of cultural heritage is intangible, losses are difficult to quantify. Different communities may value different cultural asset types differently. Accordingly, the scale comprises qualitative indicators, where the users must determine what they mean by *minor, medium* and *major* damages, as well as *near complete* and *complete* loss of accessibility.

In rating the different non-economic assets, different descriptors can be used as per ratings and descriptors in Table 13. The scope of traditional knowledge, traditional role and traditional sustainability extends well beyond agriculture and can include medicine, ecology, fishing, navigation, storytelling and much more (Sevudredre, 2023).

Table 13. Descriptors for rating non-economic assets

Cultural Asset	Rating	Descriptor
Traditional Role	5 - Very high	Traditional roles is primary means of livelihood; if farming is central to community's identity and way of life then traditional roles deeply intertwined with farming
	4 - High	Agriculture serves as key economic activity along with other pursuits; traditional roles closely tied to farming practices; farming important in shaping traditional values and traditions
	3 - Medium	Farming is of moderate importance in community; traditional roles related to farming exist but less prominent
	2 - Low	Farming plays limited role in community identity and way of life and is one of many economic activities; traditional roles associated with farming much less emphasized
	1 - Very Low	Farming has minimal influence on community identity and marginalized/abandoned; traditional roles tied to farming virtually non-existent

Cultural Asset	Rating	Descriptor
Traditional Knowledge	5 - Very high	Deep-rooted TK passed down through generations and cornerstone of community identity and resilience; traditional practices actively preserved and communicated within community to ensure continuity
	4 - High	Strong understanding of traditional practices reflecting commitment to cultural preservation; efforts to safeguard traditional practices through education and documentation promoting community resilience
	3 - Medium	Although TK is valued, its transmission is hampered by generational shifts or external influences; basic understanding of traditional practices but greater reliance on modern methods for certain activities
	2 - Low	TK is in decline and fewer community members possessing expertise of former generations; decline due to external factors eg. urbanization, cultural assimilation
	1 - Very Low	TK largely lost or marginalized with modernization and external influences displacing traditional practices; disconnect from cultural heritage and identity
Traditional Sustainability	5 - Very high	Traditional farming practices prioritize ecological sustainability using organic methods, crop rotation and natural fertilizers and farming systems promote local food security, climate change resilience and cultural preservation
	4 - High	Traditional farming methods include agroforestry, terracing and water conservation techniques to boost productivity and resilience; TK informs agricultural practices
	3 - Medium	traditional farming practices such as mixed cropping, seed saving and rainwater harvesting are employed to promote a degree of ecological sustainability although external pressures can cause modification of traditional practices
	2 - Low	Limited ecological sustainability with soil degradation, water scarcity and biodiversity loss due to unsustainable land use practices
	1 - Very Low	Unsustainable traditional farming practices causing severe environmental degradation, soil erosion and loss of crops and livestock

Cultural Asset	Rating	Descriptor
Presence of Materials	5 - Very high	Abundant and readily accessible traditional materials of high quality that can be sourced locally.
	4 - High	Traditional materials generally available with occasional shortages; local resources provide sufficient supply for construction needs
	3 - Medium	Availability of traditional materials may vary seasonally or regionally requiring careful planning; certain materials may need to be supplemented or imported
	2 - Low	Traditional materials are scarce or hard to obtain and so imported materials may need to be sourced for construction needs.
	1 - Very Low	Traditional materials are unavailable and importing materials from distant locations is the only option adding to logistical challenges and costs.
Access to Materials	5 - Very high	Communities have preserved access to wide range of natural materials and despite challenges, they have developed adaptation strategies to maintain access such as diversifying sources.
	4 - High	Communities still have relatively good access to natural materials but not with as much ease as in previous years; efforts made to protect and restore natural habitats to ensure continued access to materials
	3 - Medium	Communities face moderate challenges in accessing natural materials compounded by impacts of climate change such as habitat loss and resource depletion; adaptation efforts are underway but availability may fluctuate
	2 - Low	Access to natural materials is limited due to habitat loss and resource depletion; extraction sites may be inaccessible or depleted requiring extensive travel to find suitable alternatives
	1 - Very Low	Severe problems in accessing natural materials due to widespread damage to ecosystems; traditional extraction sites severely damaged or depleted
Social Bonds	5 - Very high	Strong bonds and mutual support foster efficient collaboration and communication among community members; deep sense of belonging and collective identity due to shared values and traditions

Cultural Asset	Rating	Descriptor
	4 - High	Strong sense of solidarity and mutual respect demonstrated among community members; common goals and shared experiences promote cohesion and facilitate collective action and decision-making
	3 - Medium	Interactions with the community are generally positive but occasional conflicts arise; although there is a sense of belonging, cohesion between groups or individuals may vary impacting collaboration.
	2 - Low	Divisions lead to limited communication and collaboration; trust and solidarity are compromised hindering collective action and decision-making
	1 - Very Low	Severe divisions and conflicts result in minimal communication and collaboration; trust is virtually non-existent leading to isolation and dysfunction
Cultural Importance of Materials	5 - Very high	Materials hold profound cultural significance and are integral to identity and heritage of the community; traditional materials are deeply intertwined with cultural ceremonies, rituals and practices
	4 - High	Materials play a significant role in preserving cultural traditions and values; traditional materials are valued for their connection to ancestral knowledge and craftsmanship enforcing community identity
	3 - Medium	Although materials hold cultural importance, their significance may vary across generations; although efforts are made to preserve traditional craftsmanship, their use may be influenced by practical considerations
	2 - Low	Cultural significance of materials may be recognized but importance may be overshadowed by cost, availability or convenience
	1 - Very Low	Materials have little to no cultural significance and use is governed by practical considerations; traditional building techniques largely abandoned in favour of modern construction methods leading to erosion of cultural heritage and identity.

The **physical expression** of these cultural assets is then surveyed in the displaced communities. The physical expressions are in the form of *yavu*, burial grounds, *sau tabu*, traditional groves, traditional houses *(bure)* at the old site and grounds used for subsistence/livelihoods *(ikanakana)*.

There is **spiritual expression** of cultural assets like oral traditions and expressions, traditional rituals and protocols and traditional craftsmanship (tapa, basket weaving etc).

Finally, there is the **social expression** of cultural assets like traditional social structures, social bonds and overall cohesion.

Activities in undertaking NEL Field Assessment

Activities in field assessment

1. **Pre-Departure Briefing**

   Before going out in the field, there needs to be a briefing in Suva. Background information on the community to be assessed needs to be gathered e.g. the village profile, the field ready cultural checklist needs to be consulted to ensure correct protocols are observed and the traditional governance structure in the community is correctly acknowledged. Transport, accommodation, Sevusevu and food for the survey team needs to be budgeted. A sample program that could be drafted for the field assessment is attached as Appendix 4.

2. **Community Consultation**

   Introduce the exercise to the community and clearly explain the reasons for the survey. The semi-structured interviews should be done in groups: men, women, youths. Consent forms should be signed by the participants allowing photos to be taken and information gathered to be used.

Activities 3 – 5 will differ in content depending on the cultural asset being assessed. The following example is for the assessment of the physical structures including traditional house mounds (yavu), burial grounds, sau tabu and traditional groves. Other cultural assets and associated activities are in Appendix 5. The list is by no means exhaustive as native trees and plants, and indigenous dialect/ language are two important assets that can be impacted by relocation (Sevudredre, 2023).

3. **Community mapping**

   - Present the topographic map showing mataqali land boundary and explain how the map should be read and the different locations
   - Ask the community to mark the yavu (house mounds), the burial grounds and sau tabu and traditional groves. These features should be marked in different colours with a colour code included in the legend.
   - Number the yavu/ burial grounds/ sau tabu / traditional groves and provide information (e,g. age, mataqali that the yavu belongs to, condition of the sites, hazards that place the sites at risk)

4. **Semi-structured Interviews and Community Matrix**

   These are to be done in groups and can be done concurrently with the mapping. The interviews should be done in groups, men, women, youths, elderly. The objectives of the questionnaires are to determine the following:

- Their attachment to the yavu/burial grounds/sau tabu and traditional groves and their feelings about moving away
- Why are some sites considered sacred/tabu? Is it because of specific flora, fauna and/or artefacts associated with these sites?
- How important is it for the community to be connected to these sites and how has the displacement impacted the connection?
- How connected are the youths to these traditional sites?

A matrix drawn on large sheets of paper and preferably completed by community members would be best.

5. **Field Verification Transect Walk**

   Visit the traditional sites to verify information and mark the sites using GPS.

6. **Team Rating**

   The assessment team should review the information gathered and rate it from 1-5 using descriptors in Table 13.

It is important to note that when rating the physical expression of cultural assets not all 7 cultural assets will be applicable. Examples shown in Table 14 below using Nabavatu matrix produced by the men for yavu, traditional bures and ikanakana, traditional craftsmanship and social structure.

7. Once ratings are done, it then has to be tied back to the risk matrix to get overall risk calculations.
8. A debrief at the end of the field trip should be done once back in Suva.

Table 14. Nabavatu Matrix

Physical feature	Cultural asset	Rating (1-5)
Yavu	Traditional role	5
	Traditional knowledge	5
	Social cohesion	5
Traditional bure	Traditional role	5
	Traditional knowledge	2
	Availability of materials	5
ikanakana	Traditional knowledge	1
Traditional craftsmanship	Traditional knowledge	5
	Availability of materials	5
	Access to materials	5
Social structure	Traditional role	5
	Traditional knowledge	5
	Social cohesion	2

Initial trials of the field assessments were done in Nabavatu and Vuniniudrovu.

The assessment of the dimension Cultural Heritage is based on the following values:

Table 15. Levels and indicators for assessing losses of cultural heritage.

Score	Cultural Heritage
5 (very high)	>50% significant loss of tangible and intangible cultural heritage
4 (high)	30 – 50% loss of tangible and intangible cultural heritage
3 (medium)	10-30% loss of tangible and intangible cultural heritage
2 (low)	5-10% loss of tangible and intangible cultural heritage
1 (very low)	<5% loss of tangible and intangible cultural heritage

Community participation and validation

Communities contribute local knowledge to the assessment of potential consequences, explain the significance of losses to their lives, livelihoods, environment and cultural heritage, and review the findings. Their perspectives inform the interpretation of risk and identification of priorities for risk reduction.

BOX 7 - Roles and responsibilities

Lead (L) and Supporting (S) Agencies

5.1 Human vulnerability / Social

L: Min. Rural and Maritime Development & Disaster Risk Management (National Disaster Management Office); Min of Public Works, Meteorological Services & Transport; Ministry of Environment and Climate Change; Min Women, Children and Social Protection; Min Multi-Ethnic Affairs and Sugar Industry; Min Youth, Min Health and Medical Services, Min Housing

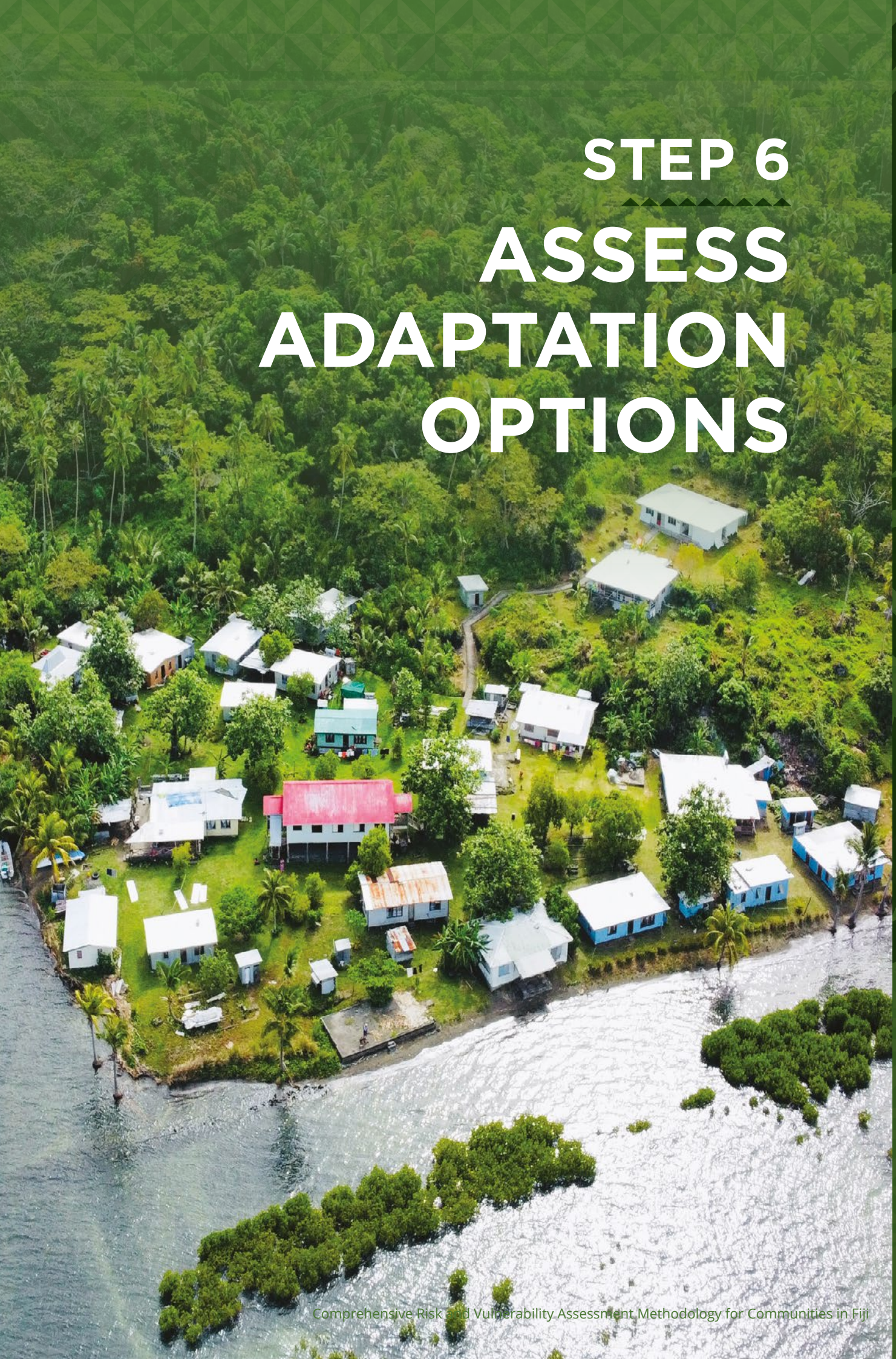
S: Min. iTaukei Affairs; iTaukei Affairs Board; Min Multi-Ethnic Affairs and Sugar Industry; Min Youth, Min Health and Medical Services, Min Housing, Min of Lands and Mineral Resources, Min Women, Children and Social Protection; Most NGOs, CBOs, FBOs involved in social vulnerability – do not have level of capacity (assessment)

Output

The output for Step 5 is a Risk Matrix that describes the likelihood and consequences of risks impacting both tangible and intangible assets.

Link to the next step

The risk assessment findings and priorities identified in Step 5 inform Step 6, which assess adaptation measures to reduce present and future risks. Step 6 considers the effectiveness, feasibility and costs of these measures, together with community priorities and the risks expected to remain after implementation.



STEP 6

ASSESS ADAPTATION OPTIONS

STEP 6 – ASSESS ADAPTATION OPTIONS

Purpose

- Assess the suitability, effectiveness, feasibility and costs of options for reducing the risks identified in Step 5.
- Compare nature-based, structural and non-structural measures, including improvements to existing measures, to inform decisions under the SOP and the consideration of relocation as a last resort.

Link to SOP

This CRVAM step supports steps 7 and 8 of phase C in the SOP (chapter 4.3. Preliminary screening, scoping, initial risk assessment) and SOP step 11 of phase D (chapter 5. Pre-stage II: Detailed assessment & planning).

Inputs required

- Use the present and future risk profiles from Step 5, adaptation studies and options register from Step 3.1, capacities and suggestions from Step 4.1, and community values from Step 1.2.
- Obtain option designs, indicative costs, implementation and maintenance information, technical advice and applicable standards.
- Use Appendix 2 for adaptation appraisal, Appendix 7 for the CBA template and Appendix 6 for building-code reference

Assessment activities

Since relocation is to be used as a "last resort", one needs to consider what other measures are available that could reduce the risk of the focal communities. These can be nature-based, structural or non-structural options and already identified through Steps 3.1 and 4.1. However, the anticipated costs and effects of these measures should also be evaluated (Step 6.1) in a structured way, which facilitates comparisons between different risk reducing options.

Proposals on adaptation measures can be attained either from published studies, expert observations (as proposed in Step 3.1) or by community members themselves. All such ideas should be scrutinized and prioritized on basis of a set of common criteria adapted from UNFCCC guidance to help LDCs prepare NAPAs. Measures should be effective in terms of reducing risk and not too expensive to implement. To ensure this, cost-benefit analyses (CBA) can be performed (further explained below). However, a good return on investments is not the sole criteria of importance. A range of approaches exist to evaluate adaptation options, including criteria developed by the UNFCCC and others[21].

21 Another alternative option to facilitate prioritizations amongst risk reducing options developed by the Federal Emergency Management Agency in the US (FEMA) is called "STAPLEE" (Coppola, 2011). The acronym contains the first letters of aspects/ factors that are important to consider, which here are listed together with some questions that may facilitate discussions:

STEP 6.1 – Assess Adaptation Options using UNFCCC Criteria

The following criteria for analysing adaptation options are adapted and expanded from the UNFCCC guidance produced to help LDCs prepare NAPAs.[22] Aligned with the SOP, these criteria may be considered.

Goals

- **Effectiveness:** will the option meet the objectives of the community? Will the community feel safer and less exposed?
- **Synergy and coherence with other strategic objectives / value addition:** does the option offer co-benefits? Does the option enable other goals such as sustainable development or conservation (e.g., mangrove protection)?
- **Efficiency:** are the achieved outputs optimal relative to allocated resources? Is it an efficient use of funding relative to the potential risk reduction benefits?
- **Equity:** will the option benefit vulnerable members of the community? Are people with pre-existing vulnerabilities able to access benefits of the adaptation option?
- **Design** – does not create additional or add on problems – not create environmental issue; donor design to comply with minimum engineering standards and to be compliant with Fiji National Building Code. (See Appendix 6 for Fiji National Building Code)

Maintenance by community

Timing

- **Robustness:** is the option robust under a range of future climate projections? Will it offer risk reduction gains at differing emissions scenarios and timeslots?
- **Flexibility:** is the option flexible, and will it allow for adjustments and incremental implementation and reiteration depending on the year and scenario of climate change? Are there ways to improve risk reduction benefits over time? (maintenance?); design
- **Practicality:** can the option be implemented on relevant timescales? Will it offer benefits that match the timeline of the community? – source of funding
- **Urgency:** how soon does the option need to be implemented? Is that realistic?
- **Sustainability:** Does the community have the capacity and capability to manage over time? Are there plans in place for capacity building if needed?

Social: Is the measure socially acceptable (i.e., does it comply with local values & cultural norms)? Can it have different effects in different segments of society? Does it have short- and long-term impacts on social structures? Technical: is the measure technically feasible? Is it a long-term/sustainable solution, i.e., does the necessary know-how and spare parts exist to operate and maintain it? Administrative: does the measure require any staff (qualifications/quantity)? Does it incur running costs (if so, how to secure funding and is a system needed to administer it?) Political: does the measure enjoy political support (or does it entail political risks?). Does it enjoy public support (including from private business & interest organizations) Legal: does the measure comply with existing laws? Permission(s) required? Foreseen legal problems? Economic: is the measure cost-effective/reasonable concerning size of problem and likely benefits? Who pays? Long- and short-term funding? Environmental: does the measure have any positive or negative effects on land/water/air (affecting sensitive areas)? Long- and short-term effects? Compliant with environmental goals?

22 Even though Fiji is not an LDC, these criteria may be considered and adapted in this context. Analysing Climate Change Adaptation Options Using Multi-Criteria Analysis. See more: https://www.climatelinks.org/sites/default/files/asset/document/Multi-Criteria%2520Analysis_CLEARED_0.pdf

Acceptability

- **Political acceptability:** is the option politically acceptable for the community?
- **Social acceptability:** Is the option socially acceptable for the community?
- **Cultural acceptability:** Is the option culturally acceptable for the community?

To facilitate decision-making, the outputs of the discussions can also be documented with the help of a template (see Fig. 7.)

Figure 7: Template Cost-Benefit Analysis

	GOALS				TIMING					ACCEPTABILITY		
Considerations	Efficiency	Effectiveness	Equity	Co-benefits	Urgency	Sustainability	Flexibility	Robustness	Practicality	Social	Cultural	Political
Option A:												
Option B:												
....												
Option D:												

In this template, simplified and adapted from UNFCCC and FEMA approaches, proposals on risk reducing measures are listed in the left column and considerations listed on the right. This is more or less a checklist to make sure all important aspects are considered. A simple way of using the template, is to place a tic in each box that the measure affects in a positive way (or at least does not affect in unacceptable ways). Measures with the most ticks thus get a higher priority. However, a simple "tic" does not reveal how large impacts the measure could have for each category. It is also possible that one would like to highlight areas for which the measure might have negative effects. To signal the strength of a measure's impact on different areas, one may exchange the tic for an L, M or H where L stands for low impact, M for medium impact and H for high impact. These levels of impact can then be attributed with numbers (L=1, M=2, H=3) and combined with a C" for Cost or a "B" for Benefit (i.e., a measure with high benefits for a particular aspect would then be denoted by a "BH" in the designated box for that aspect). In case the adaptation measure neither has a positive, nor negative effect, for a particular category, one may write N/A and allocate 0 points for that answer. A value for each measure can then be calculated by subtracting all the points it receives for costs from those it receives for benefits. This value may then be used to compare and prioritize between alternative risk reducing options[23].

This template is a structured way of estimating the merits and drawbacks of risk reducing proposals. Yet, it is a coarse means of making cost-benefit analyses as it does not specify how much money a measure cost, which undoubtedly is of interest to decisionmakers as well. To this end, a method to estimate financial costs of risk reducing measures is presented below.

23 NOTE: since communities are different, one and the same adaptation measure analysed with this template may result in very different outcomes in different places.

STEP 6.2 – Assess options with Cost-Benefit Analyses (CBA)

Basically, all adaptation measures incur costs, and the intended impact of such activities is a reduced risk level, often expressed in lower expected damages. Funds required for risk reducing measures are compared with anticipated benefits to decide whether the investment is worthwhile and different suggested measures may be compared in this regard.

CBA is the main economic project appraisal technique and commonly used by governments and public authorities for public investments. CBA origins in the rate-of return assessment/financial appraisal methods undertaken in business operations to assess whether investments are profitable or not. However, CBA in the context of disaster risk management takes a wider point of view and aims at estimating the profit for society (Mechler, 2005).

CBA requires recorded data or estimates of damages/losses expected under current conditions in a location. Ideally, historic damage data are correlated with characterized hazard events. If such data are not available, expert estimations are used. Damages are expressed in average annual losses (AAL). It is assumed that such damages will continue in the future. With general economic developments, assets tend to increase faster than inflation. For this reason, projections for future damages must factor this in, resulting in an increase in damages. Furthermore, climate change induced increased severity and/or frequency of hazards may also increase expected damages and should be included as well.

On the cost side, two different expenses should be distinguished: investment and running costs. Investment costs are those initially needed to establish a risk reduction measure, while running costs consist of all cost for continuous operations, maintenance, and depreciation. Both expected damages and running costs are subject to the same amount of inflation, which therefore is ignored.

The implementation of activities aims at reducing damages. The degree of the reduction is calculated or estimated and regarded as costs saved. The investment/running costs are compared with the future savings. If savings are bigger than establishing/running costs, the activity is economically viable. Usually, it takes several years until the break-even point is reached. An example of a CBA spreadsheet calculation for an early warning system is provided in Appendix 7.

Risk presentation is described in more detail in the SOP step 11 of phase D (chapter 5. Pre-stage II: Detailed assessment & planning). Having calculated the risks and identified suitable risk reducing measures, these findings should be presented by a representative of the assessment team to the decision-making body that evaluates whether, and if so, which adaptation measures that should be implemented where and when. Aside from relevant authorities, this decision-making body should comprise representatives of the assessed communities, owners of potential relocation sites and people already living in or near these sites. The presentation should cover:

- current and projected risk levels for focal communities
- assumed effects and costs of adaptation measures.

Ideally, the presentation should display a risk matrix where all assessed scenarios are plotted as well as a table providing an overview of risk scores as illustrated in Step 5 above. The effects and costs of adaptation measures could further be presented by help of the template provided in Appendix 7.

This CRVAM step supports step 8 of phase C in the SOP (chapter 4.3. Preliminary screening, scoping, initial risk assessment Section III, Page 26) and SOP step 11 of phase D (chapter 5. Pre-stage II: Detailed assessment & planning – Section III, Page 32).

Risk evaluation and decision-making is described in more detail in the SOP step 11 of phase D (chapter 5. Pre-stage II: Detailed assessment & planning).

Community participation and validation

Communities propose measures and discuss whether options would work in everyday life. They explain preferences, possible adverse effects and practical requirements, including whether maintenance responsibilities are realistic and adequately supported.

BOX 8 - Roles and responsibilities

Lead (L) and Supporting (S) Agencies
7. Assess Adaptation Measures **L:** DoCC, Min. Rural Maritime Development & Disaster Risk Management, Min. of Lands and Mineral Resources, Min. of Agriculture & Waterways, Min. of Forestry & Fisheries, Min. of iTaukei Affairs. **S:** Min. of Public Works, Meteorological Services and Transport, Min of Agriculture and Waterways; Min of Fisheries & Forestry, Min of iTaukei Affairs NDMO; SPC; FBOS; DoCC/ UNOSAT; Development Partners; Min of Lands and Mineral Resources;

Output

The main output for Step 6 is a Cost Benefit Analysis of the different adaptation options.

Link to the next step

The output will inform SOP decisions on risk reduction and whether potential relocation sites need assessment in Step 7. Where further in-place options remain viable, record the next actions and assessment needs. If relocation sites are assessed, compare their risks and requirements with the outcomes achievable through adaptation at the existing location.

STEP 7

ASSESS POTENTIAL RELOCATION SITES



STEP 7 – ASSESS POTENTIAL RELOCATION SITES

Purpose

- Identify and compare potential relocation sites where the SOP processes indicates the need to explore relocation.
- Assess whether potential sites can provide lower risk while supporting livelihoods, essential services, cultural continuity and the wellbeing of affected communities including relocating and host communities.

Link to the SOP

This CRVAM step is supporting SOP steps 7 of Phase C and 12 of phase E (chapter 5. Pre-stage II: Detailed assessment & planning) and SOP step 23 of Phase K (chapter 6. In-stage II: Relocation & Establishment).

Inputs required

- Step 1: Scope, community profile and values
- Step 2 – 5: Present and future assessments
- Step 6: Adaptation and residual-risk findings

Obtain potential site information, land and boundary records, host-community information, access and service data, infrastructure and livelihood requirements, and relevant technical survey. Draw on site preferences recorded during the community survey.

Assessment activities

If realizing that relocation is the only option, one also needs to know to which places at-risk communities could move. This does not only depend on their demographic and socio-economic profile, but whether alternative locations offer access to, for example, critical infrastructure and livelihood opportunities and are less exposed to hazards compared to the current location. Relocation site criteria should be elaborated through focal group discussions with community members (Step 7.1) and be the basis for suitability mapping (Step 7.2) supported by the Fiji CC GIS Portal.

Hereafter, the potential relocation sites should be subjected to an almost identical (but somewhat simpler as described in Appendix 1) risk assessment as was conducted for the communities' present locations (Steps 3-7). The results of the assessments for the relocation sites should then be presented for the decision-making body (Step 7.1) with similar types of risk matrices and tables as suggested in Step 5.

STEP 7.1 – Criteria for selection of relocation site

The identification of suitable relocation sites is partly based on the exposure assessments (Step 3.2). However, relocation sites should not solely be chosen on basis that they are less exposed to the focal hazards than the communities' present locations. The new sites should also meet several other needs that communities have, such as livelihood opportunities, access to education, healthcare, and other commodities[24]. The survey mentioned in Step 4.1, also comprises questions to the communities about what such relocation site criteria may be[25]. The answers to these questions should be used as basis for suitability analyses/mapping with the support of GIS (Step 7.2), where geographic datasets can be queried and display locations that meet such predefined criteria[26]. Last, but not least, the current owner/governmental agency or host community living in the proposed relocation site should be consulted and engaged in the process of determining a site's suitability.

STEP 7.2 – Assess risks and suitability of potential relocation site(s)

Having identified potential relocation sites, these should be subjected to the same kind of risk assessment as was done for the communities' present locations (i.e., one must redo parts of Steps 3-7 for the prospective relocation sites). To simplify the assessment and avoid introducing large uncertainties (speculations), we assume that the geographic extent; number and types of physical structures as well as the number and socioeconomic features of the population remain the same in the future (at the chosen timeslot(s) for climate change projections). This means that the vulnerability assessment already conducted for the community in Step 4, can be reused. However, the risk for potential relocation sites needs to be calculated with regards to future projections (Step 5.2) as one wants to be assured that these sites will remain safe at varying future timeslots. In addition, it is essential to assess whether adaptation measures could/should be implemented to further reduce potential risk at the relocation sites, following the same approaches as for the origin site (Step 6.1). The results of the assessments for the relocation sites should then be presented with similar types of risk matrices and tables as for the site of origin, in accordance with the SOPs.

In some cases, only part of a community is significantly threatened by hazards. If so, residential buildings at high risk may move within the community land while less endangered buildings may remain where they are. Such partial relocations are expected to change little in terms of access to infrastructure, services or livelihood opportunities and the assessment of possible sites for buildings will be the decisive factor for the decision about the relocation. For further guidance on partial relocations, see SOPs.

24 It is also important to know whether there are any people already living in and near potential destination sites, and to consider their needs and preferences (e.g., whether relocating persons have close connections and positive relations with these people).

25 The Interagency Durable Solutions Indicator Library (https://inform-durablesolutions-idp.org/) contains important aspects to consider when seeking to attain durable solutions for the relocation of internally displaced persons (IDPs), and hence a good basis for discussions on relocation site criteria. UNHCR (2014), Ferris (2017) and AECOM (2016, notably section 2-3) are three other useful sources to this end.

26 This technique has already been utilized in Fiji by UNOSAT in the "CommonSensing" project and it is presumed that in-country GIS experts, alternatively UNOSAT, can support persons who implement the CRVAM with these analyses should they need such assistance.

Community participation and validation

Communities help identify what a suitable site must provide and review potential site. Potential host communities, landowners and other affected persons/communities contribute their own needs, concerns and knowledge.

BOX 9 - Roles and responsibilities

Lead (L) and Supporting (S) Agencies

Define Relocation Criteria with Communities

L: Min. Rural and Maritime Development and Disaster Risk Management; iTaukei Affairs Board; DoCC; FTRD
S: Min. Lands and Mineral Resources; Min. of Public Works, Meteorological Services and Transport; Min. Agriculture, Min. Fisheries & Forestry; Min. Health and Medical Services; Min. Environment and Climate Change; Min Commerce, Trade, Tourism & Transport

Conduct Suitability Mapping

L: Min. Rural and Maritime Development and Disaster Risk Management; iTaukei Affairs Board; DoCC; Min. Lands and Mineral Resources; FTRD
S: UNOSAT; SPC; Min. iTaukei Affairs

Select Potential Relocation Sites

L: FTRD; Min. Rural Maritime Development & Disaster Risk Management; Min. Lands & Minerals Resources Department
S: Min. iTaukei Affairs

Output

The main output for Step 7 is the identification of a relocation site which will have undergone the necessary screening process to ensure suitability.

Link to the next step

Submit the assessment for the subsequent decisions, planning, approvals and consent processes required by the SOP. Revisit Steps 1 - 6 where potential sites or proposed designs change the evidence or assumptions. Carry the assessment record into implementation and monitoring so that changes in risk, community circumstance and site conditions can be addressed.

Completion of the seven CRVAM steps provides an evidence base for decisions under Fiji's SOP on reducing community risk, assessing adaptation measures and, where necessary, considering planned relocation. The findings bring together present and future risks, community values and priorities, adaptation options and the suitability of potential relocation sites. They should inform agreed next actions, with responsibilities and outstanding assessment needs clearly documented. The assessment should be reviewed as conditions change, and its findings do not replace the consultation, consent and approval processes required under the SOP.

REFERENCES

AECOM (2016). Shishmaref Relocation Site Selection Feasibility Study. Accessed December 4, 2022 from https://www.commerce.alaska.gov/web/Portals/4/pub/Shishmaref_Site_Selection_Feasibility_Study_ FINAL_022316.pdf

Boholm, A., Corvellec, H., & Karlsson, M. (2012). The practice of risk governance: lessons from the field. Journal of Risk Research, 15(1), 1-20. doi:10.1080/13669877.2011.587886

Bloemendaal, N., Moel, H., Martinez, A., Muis, S., Haigh, I. D., van der Wiel, K., Haarsma, R. J., Ward, P. J., Roberts, M. J., Dullaart, J. C. M., Aerts, J. (2022). A globally consistent local-scale assessment of future tropical cyclone risk, Science Advances, 8 (17). doi: 10.1126/sciadv.abm8438

Charan, D., Kaur, M. & Singh, P. (2017). Customary Land and Climate Change Induced Relocation—A Case Study of Vunidogoloa Village, Vanua Levu, Fiji. In W. Leal (Ed.), Climate Change Adaptation in Pacific Countries (pp. 19-33). New York: Springer.

Coppola, D. P. (2011). Introduction to international disaster management, (2 ed). Ch. 4 Mitigation (pp. 242- 246), Oxford: Butterworth-Heinemann (Elsevier)

CSIRO and SPREP (2021). 'NextGen' Projections for the Western Tropical Pacific: Current and Future Climate for Fiji. Final report to the Australia-Pacific Climate Partnership for the Next Generation Climate Projections for the Western Tropical Pacific project. Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Secretariat of the Pacific Regional Environment Programme (SPREP), CSIRO Technical Report, Melbourne, Australia. doi: 10.25919/5gh8-qt86

Ferris E. (2017) A Tool Box: Planning Relocations to Protect People from Disasters and Environmental Change. Washington, DC: Institute for the Study of International Migration, UNHCR, International Organization for Migration.

Fiji Government. (2017). 5-year and 20-year National Development Plan. Accessed August 10, 2024 from https://www.fiji.gov.fj/getattachment/15b0ba03-825e-47f7-bf69-094ad33004dd/5-Year-20-Year- NATIONAL-DEVELOPMENT-PLAN.aspx

Fiji Government. (2018a). Climate Vulnerability Assessment. Making Fiji Climate Resilient. Fiji Government, the World Bank, and GFDRR. Suva.

Fiji Government. (2018b). Planned Relocation Guidelines, A Framework to undertake climate change related relocation. Ministry of Economy and GIZ, Suva.

Fiji Government. (2018c). National Climate Change Policy. Ministry of Economy. Accessed August 10, 2022 from https://fijiclimatechangeportal.gov.fj/ppss/republic-of-fiji-national-climate-change-policy-2018-2030/

Fiji Government. (2018d). National Adaptation Plan. Accessed August 10, 2022 from https://www4.unfccc.int/sites/NAPC/Documents/Parties/National%20Adaptation%20Plan_Fiji.pdf

Fiji Government. (2019). Climate Relocation of Communities Trust Fund Act 2019: An act to establish a trust fund for the planned relocation of communities in Fiji that are adversely affected by climate change; Act No. 21 of 2019. Suva, Fiji.

Fiji Government. (2024) Fiji World Heritage Act 2024. Accessed October 26, 2026 from Act-17-Fiji-World-Heritage-Act-2024.pdf

GFDRR. (2014). Understanding Risk in an Evolving World. Emerging Best Practices in Natural Disaster Risk Assessments. Washington: Global Facility For Disaster Reduction And Recovery. Accessed August, 27, 2022 from https://www.gfdrr.org/sites/default/files/publication/Understanding_Risk-Web_Version-rev_1.8.0.pdf

Hagelsteen, M., Becker, P. (2014). Forwarding a challenging task: seven elements for capacity development for disaster risk reduction, Planet@ Risk 2 (2), 94–97.

Höök, M., Sivertsson, A., & Aleklett, K. (2010). Validity of the Fossil Fuel Production Outlooks in the IPCC Emission Scenarios, Natural Resources Research, 19(2), 63-81. doi:10.1007/s11053-010-9113-1

IDMC (2022). Flood displacement risk: Assessment for Fiji and Vanuatu in current and future climate scenarios. Accessed March 9, 2023 from https://www.internal-displacement.org/publications/flood-displacement-risk-assessment-for-fiji-and-vanuatu-in-current-and-future-climate

IEC. (1995). International Standard 60300- 3-9, Dependability management - Part 3: Application guide - Section 9: Risk analysis of technological systems, International Electrotechnical Commission.

IUCN. (2016). Resolution 69 on Defining Nature-based Solutions (WCC-2016-Res-069). IUCN Resolutions, Recommendations and Other Decisions 6–10 September 2016. World Conservation Congress Honolulu, Hawaii, USA. Accessed December 2, 2022 from https://portals.iucn.org/library/sites/library/files/resrecfiles/WCC_2016_RES_069_EN.pdf

IPCC. (2014). Adaptation needs and options. [Noble, I.R., S. Huq, Y.A. Anokhin, J. Carmin, D. Goudou, F.P. Lansigan, B. Osman-Elasha, and A. Villamizar (eds.)]. In: 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 [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 833-868.

IPCC. (2021). Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson- Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Pan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yeleki, R. Yu and B. Zhou (eds.)]. Cambridge University Press.

IPCC (2022a). Annex II: Glossary [Möller, V., R. van Diemen, J.B.R. Matthews, C. Méndez, S. Semenov, J.S. Fuglestvedt, A. Reisinger (eds.)]. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 2897–2930, doi:10.1017/9781009325844.029

IPCC. (2022b). Cross-Chapter Paper 2: Cities and Settlements by the Sea. [Glavovic, B.C., R. Dawson, W. Chow, M. Garschagen, M. Haasnoot, C. Singh, and A. Thomas (eds.)]. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 2163–2194, doi:10.1017/9781009325844.019.

IRDR. (2015). Guidelines on Measuring Losses from Disasters: Human and Economic Impact

Indicators (IRDR DATA Publication No. 2). Beijing: Integrated Research on Disaster Risk. Accessed August 30, 2022 from https://www.preventionweb.net/publication/guidelines-measuring-losses-disasters-human-and- economic-impact-indicators

IRGC. (2006). White Paper on Risk Governance: Towards an Integrative Approach. Accessed August 29, 2022 from https://www.preventionweb.net/publication/risk-governance-towards-integrative-approach

ISO. (2018). ISO 31000:2018. Risk Management – Guidelines, International Organization for Standardization. Accessed May 5, 2022 from https://www.iso.org/standard/65694.html

Johnson, D. L., Ambrose, S. H, Bassett, T. J., Bowen, M. L., Crummey, D. E., Isaacson, J. S., Johnson, D. N., Lamb, P., Saul, M., & Winter-Nelson, A. E. (1997). Meanings of environmental terms. Journal of Environmental Quality 26: 581–589.

Laherrère, J. (2019). Are there enough fossil fuels to generate the IPCC CO2 baseline scenario? Paper published online, Aspo. Accessed August 28, 2022 from https://aspofrance.files.wordpress.com/2019/08/ipccco2rcp.pdf

Lane, C. E. (2008). It's more than just numbers: How to implement a qualitative risk analysis approach. Paper presented at the 18th Annual International Symposium of the International Council on Systems Engineering, INCOSE 2008, Utrecht, The Netherlands.

Mechler, R. (2005). Cost-benefit Analysis of Natural Disaster Risk Management for Developing Countries, Eschborn: Gesellschaft für Technische Zusammenarbeit. Accessed August 26, 2022 from https://pure.iiasa.ac.at/id/eprint/7320/1/Cost-B-A.pdf

Månsson, P., Abrahamsson, M., & Tehler, H. (2017). Aggregated Risk: An Experimental Study on Combining Different Ways of Presenting Risk Information. Journal of Risk Research, published online. doi: 10.1080/13669877.2017.1391315

Piggott-McKellar, A. E., McNamara, K. E., Nunn, P. D. & Sekinini, S. T. (2019). Moving People in a Changing Climate: Lessons from Two Case Studies in Fiji. Social Sciences, 8,133. doi:10.3390/socsci8050133

Restrepo, L. F. (1995). Combining qualitative and quantitative risk assessment results into a common risk measure. Paper presented at the American Society of Mechanical Engineers, Pressure Vessels and Piping Division (Publication) PVP, Honolulu, United States.

Ruth, B. M. (1982). How probable is probable? A numerical translation of verbal probability expressions. Journal of Forecasting, 1(3), 257-269. doi:10.1002/for.3980010305

Sevudredre, S. (2023). Culture-Gender-Relocation Nexus in iTaukei Villages. Suva: GIZ.

Slovic, P. (2001). The risk game Journal of Hazardous Materials, 86 (1-3), 17-24. doi:10.1016/S0304- 3894(01)00248-5

SPC, SPREP, & GIZ. (2016). Integrated Vulnerability Assessment for Atoll Islands. A Collaborative Approach. Suva. Accessed December 6, 2022 from https://www.sprep.org/publications/integrated-vulnerability-assessment-framework-for-atoll-islands-a-collaborative-approach

SPC. (2017). Tukuraki village relocates to new site, post land-slide disaster. Accessed August 10, 2022 from https://www.spc.int/updates/news/2017/10/tukuraki-village-relocates-new-site-post-land-slide-disaster

UNDRR. (2009). 2009 UNISDR terminology on Disaster Risk Reduction. Accessed December 1, 2022 from https://www.undrr.org/publication/2009-unisdr-terminology-disaster-risk-reduction

UNDRR. (2017). Technical Guidance for Monitoring and Reporting on Progress in Achieving the Global Targets of the Sendai Framework for Disaster Risk Reduction. Geneva: United Nations Office for Disaster Risk Reduction. Accessed August 31, 2022 from https://www.unisdr.org/files/54970_techguidancefdigitalhr.pdf

UNDRR. (2020). Terminology. Accessed December 1, 2022 from https://undrr/terminology

UNDRR. (n.d.). DesInventar. United Nations Office for Disaster Risk Reduction. Accessed August 18, 2022 from https://www.desinventar.net

UNFCCC. (1992). United Nations Framework Convention on Climate Change, Article 1. Accessed August 29, 2022 from http://unfccc.int/resource/docs/convkp/conveng.pdf

UNHCR, Brookings-LSE, ISIM. (2015). Guidance on protecting people from disasters and environmental change through planned relocation. United Nations High Commissioner for Refugees. Accessed December 2, 2022 from https://www.brookings.edu/research/guidance-on-protecting-people-from-disasters-and-environmentalchange-through-planned-relocation/.

UNHCR. (2014). Planned Relocations, Disasters and Climate Change: Consolidating Good Practices and Preparing for the Future. Report of the Sanremo Consultation, March 12–14. United Nations High Commissioner for Refugees. Accessed December 3, 2022 from https://www.unhcr.org/54082cc69.pdf.

van Asselt, M. B. A., & Renn, O. (2011). Risk governance. Journal of Risk Research, 14(4), 431-449. doi:10.1080/13669877.2011.553730

APPENDICES

APPENDIX 1 Mapping Community Hazards

Community Risk Mapping: A Step-by-Step GIS Processing Manual for Village Assessments

Introduction & Goal: This manual provides technical officers with a standardised, reproducible workflow to assess community hazard exposure and physical vulnerability. It bridges raw spatial data and actionable outcomes for local stakeholders, detailing the exact Geographic Information Systems (GIS) procedures required to generate hazard maps and Average Annual Loss (AAL) data tables for any village assessment in Fiji. By following these steps, officers can efficiently process baseline data such as riverine flooding or coastal storm surges into clear, numerical damage estimates required for disaster risk evaluation.

Phase 0: Workspace Setup & Data Management

Before opening QGIS, structuring your project folders and verifying your source files will prevent broken data links and lost work.

0.1 The Source Files

Ensure you have downloaded and unzipped the following mandatory files from the Fiji GIS hazard and vulnerability data sources (as of 19.09.2023):

- **Raster Files (Grid Data):** Digital Elevation Model (DEM) and Hazard grids (e.g., flood depth, storm surge inundation).
- **Vector Files (Point/Line/Polygon Data):** National coastline, river centrelines, and gazetted community boundaries.
- **Tabular Data (Spreadsheets):** Standardised structural vulnerability curves (Excel sheets defining damage percentage vs. hazard magnitude).

0.2 Standardised Folder Architecture

Set up your root directory exactly like this to ensure QGIS project files do not break when sharing work with other officers:

- 🗁 Community_GIS_Assessments *(Root Folder)*
  - 🗁 00_Shared_Fiji_Base_Data *(National hazard grids and DEMs)*
  - 🗁 01_Vuniniudrovu_Riverine *(Village Case Study 1)*
    - 🗁 01_Data
      - 🗁 Spatial
        - 🗁 Raster *(Cropped satellite imagery, localized hazard grids)*

        - Vector *(Digitized building centroids, village boundary shapefiles)*
        - Tabular *(Demographic data, vulnerability curves)*
    - 02_QGIS_Workspace *(Save .qgz project files here)*
    - 03_Outputs
        - Maps *(Final exported cartographic PDFs/PNGs)*
        - Tables *(Exported CSVs and final Excel sheets)*
- 02_Vunidogoloa_Coastal *(Village Case Study 2)*
    - *(Mirror the exact same subfolders as Village 1)*

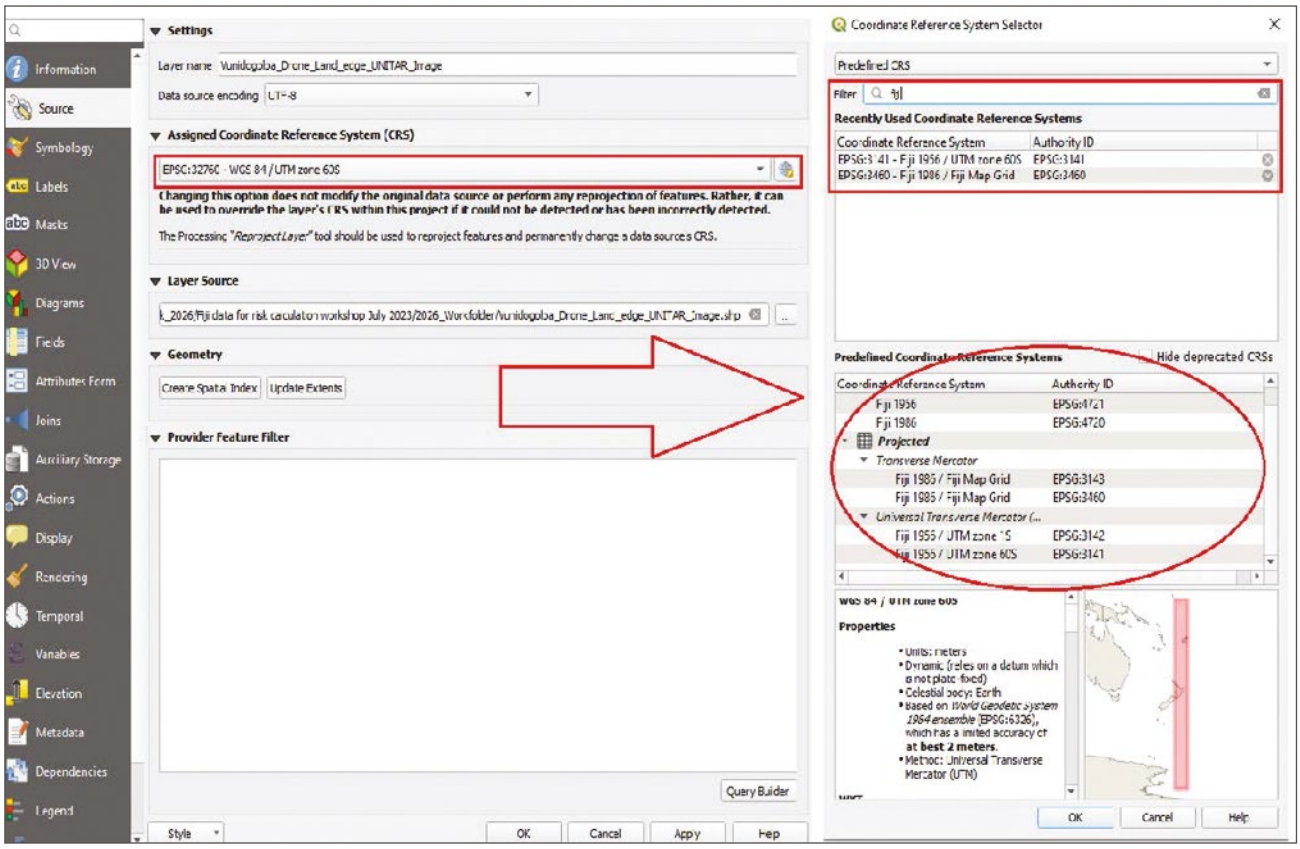
Phase 1: Data Preparation and Workspace Setup

Ensure your GIS environment is properly configured and all datasets are standardised.

1.1 Coordinate Reference System (CRS) Alignment

- **Crucial Step:** Load all raster and vector layers into your QGIS workspace.
- Right-click each layer, select **Properties > Source**, and ensure every single layer is projected to the exact same local CRS (e.g., Fiji Map Grid 1986).

NOTE: Geoprocessing tools will fail or output blank NULL values if the CRS does not match perfectly across all layers.



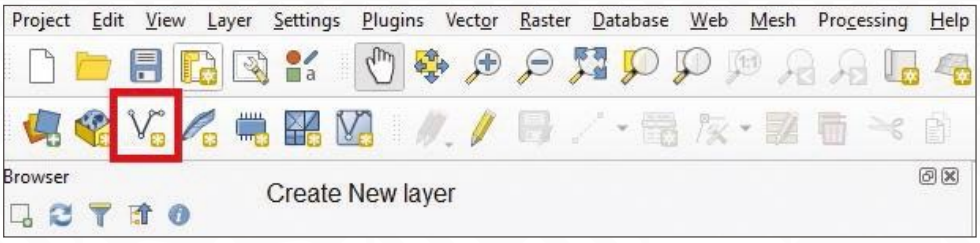
Phase 2: Mapping the Village (Asset Exposure)

This phase establishes the exact location of all physical structures within the community to calculate expected damages.

2.1 Digitizing Building Centroids

Point centroids are preferred over full polygons to allow for rapid, automated damage calculations.

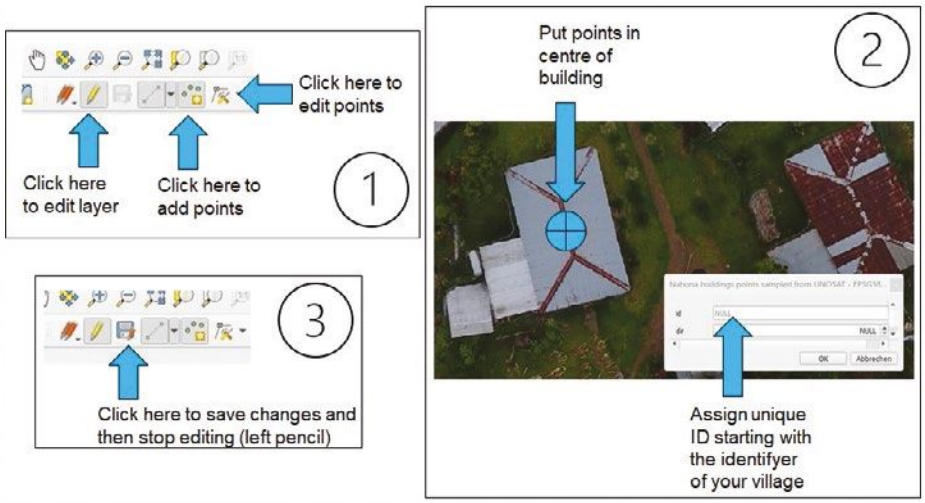
1. **Navigate to Layer > Create Layer > New Shapefile Layer.**



2. **Set the Geometry Type to Point. Add a text field named Struct_Type (e.g., residential, community hall, church).**



3. **Toggle Editing on. Using the satellite imagery as a guide, drop a single point in the exact center of every building in the village.**



4. **Save your edits and toggle off the editing mode. (map after plotting all your points)**



Buildings for AAL_Vuniudrovu — Features Total: 56, Filtered: 56, Selected: 0

	ID_1
1	Vuniniudrovu-001
2	Vuniniudrovu-002
3	Vuniniudrovu-003
4	Vuniniudrovu-004
5	Vuniniudrovu-005
6	Vuniniudrovu-006
7	Vuniniudrovu-007
8	Vuniniudrovu-008
9	Vuniniudrovu-009
10	Vuniniudrovu-010
11	Vuniniudrovu-011
12	Vuniniudrovu-012
13	Vuniniudrovu-013
14	Vuniniudrovu-014
15	Vuniniudrovu-015
16	Vuniniudrovu-016
17	Vuniniudrovu-017

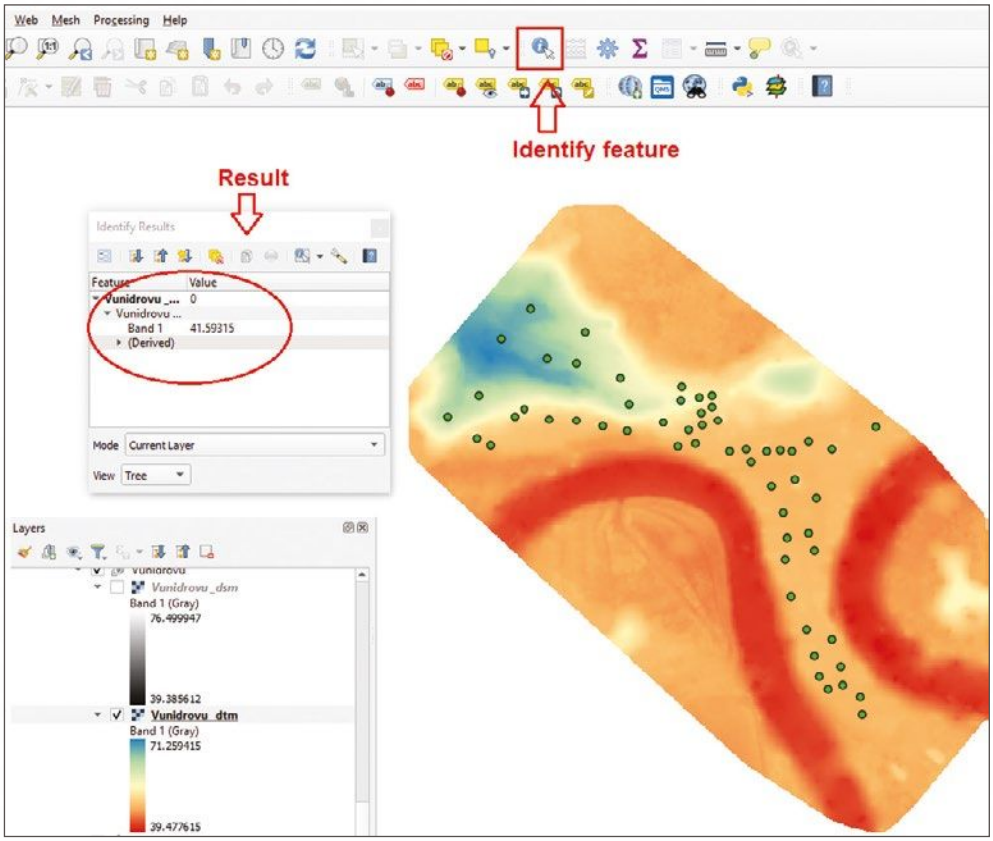
Show All Features

Once all the building points have been plotted, your attribute table should look like the example below. As mentioned in Section 2.1, notice that every single building in the village has been assigned a Unique ID.

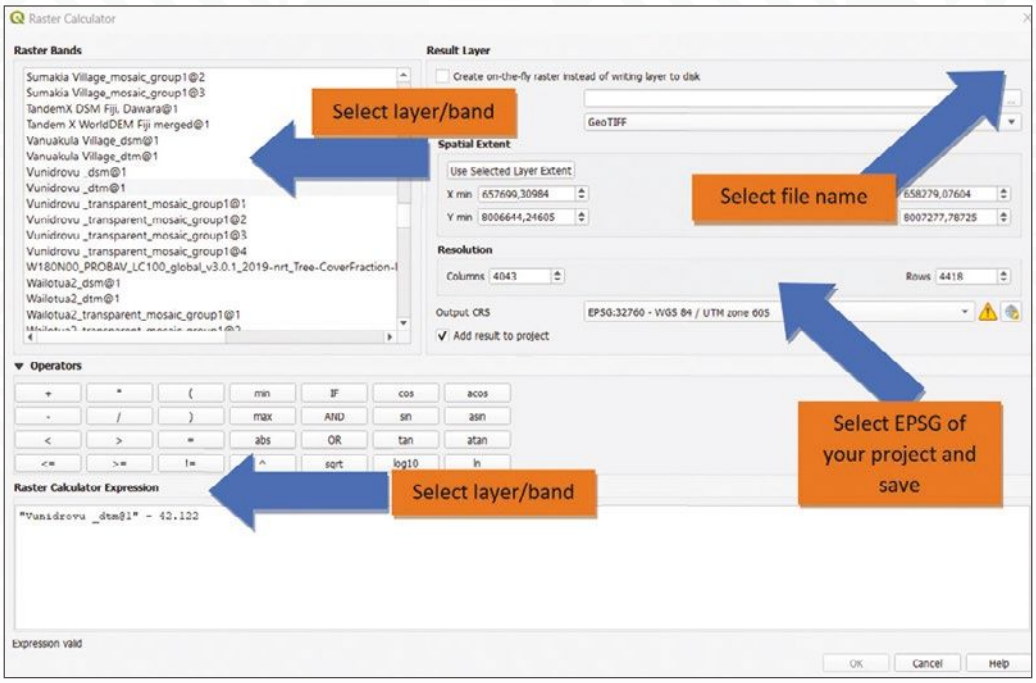
2.2 Determining the Baseline Water Elevation (Simplified HAND Method)

To predict flood severity, we must calculate how high a building's foundation (plinth) sits above the nearest river, lake, or sea. This baseline water height will be used later in your Excel tables to calculate the exact inundation depth. While large river systems require complex Height Above Nearest Drainage (HAND) modelling, you can use this simpler averaging method for short river sections with minimal elevation changes.

1. **Select the Tool:** Click the Identify Features tool (the cursor with an  icon) in your QGIS toolbar.
2. **Sample the Water Elevation:** Click directly on the water body (e.g., the river or shoreline) on your map. A results panel will appear showing the elevation for that specific spot (for example, it may read 41.59 m).
3. **Calculate the Average:** Because water levels can vary slightly on the map, click on 3 to 5 different spots along the water body right next to the village. Estimate the average of these elevation readings. This average number is your official baseline reference height.

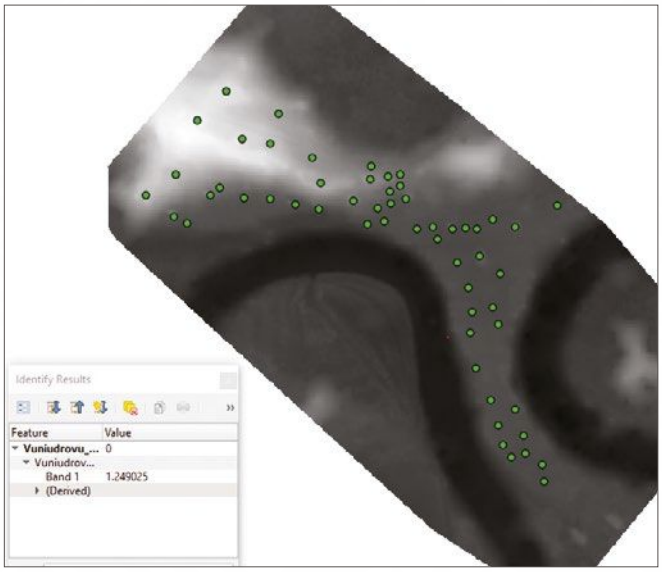


4. **Set the Water Baseline to Zero:** In the next data processing step, you will subtract this average reference height from your entire Digital Terrain Model (DTM). This essentially resets the local water level (whether river or sea) to "0" using Raster Calculator.



5. **Determine the Relative Elevation:** Because the water is now set to 0, every elevation point on your newly generated DTM represents its true height above that specific water body.

⚠️ **Important Distinction:** The resulting DTM now uses the adjacent water body as its absolute reference ("0"). This should not be confused with Mean Sea Level (MASL). For example, a house might sit 40 meters above sea level, but if it is only 2 meters above the local river, the local river baseline ("0") is what we must use to measure flood risk.



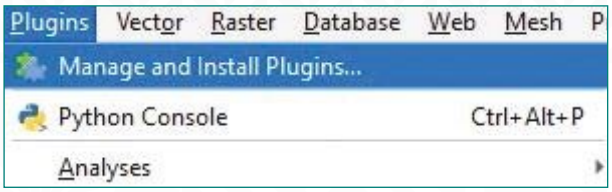
This is the output from the Raster Calculator- you can see the difference in the Identify Results because this new layer of resulting DTM now uses the adjacent water body as its absolute reference ("0")

Installing the "Point Sampling Tool" Plugin

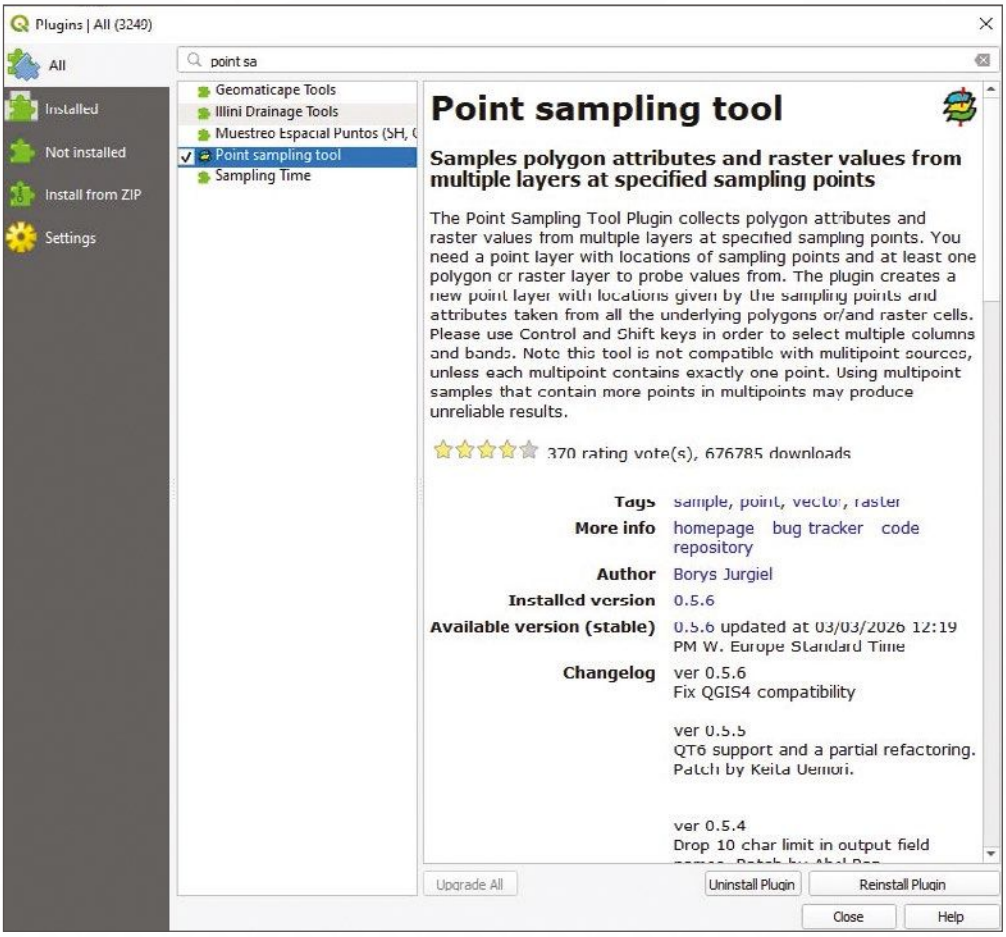
Before we can extract the water depth data and stamp it onto our houses, we need to add a special tool to QGIS. QGIS relies on "plugins" to do specific tasks, think of this like downloading a new app on your smartphone to give it a new feature.

For this assessment, we need the **Point Sampling Tool** 

1. **Open the Plugin Manager:** Ensure your computer is connected to the internet. Look at the very top menu bar in QGIS, click on **Plugins**, and then select **Manage and Install Plugins**... from the dropdown menu.

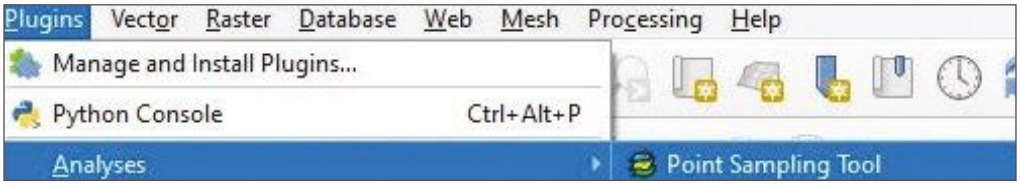


2. **Search for the Tool:** A new window will open. Click on the **All** tab on the left side of the window. In the search bar at the top, type in the name of the tool exactly as it appears below:



3. **Install the Plugin:**
   - Find the Point Sampling Tool in the search results list and click on it once to highlight it.
   - Click the Install Plugin button located at the bottom right of the window.
4. **Finish and Close:** QGIS will take a few seconds to download the tool. Once it is finished, the button will change to say "Uninstall Plugin." You can now click Close.

💡 **Where did it go?** Now that it is installed, you can find the Point Sampling Tool anytime by clicking Plugins in the top menu bar, looking under **Analyses**, and clicking the new **Point Sampling Tool** icon.



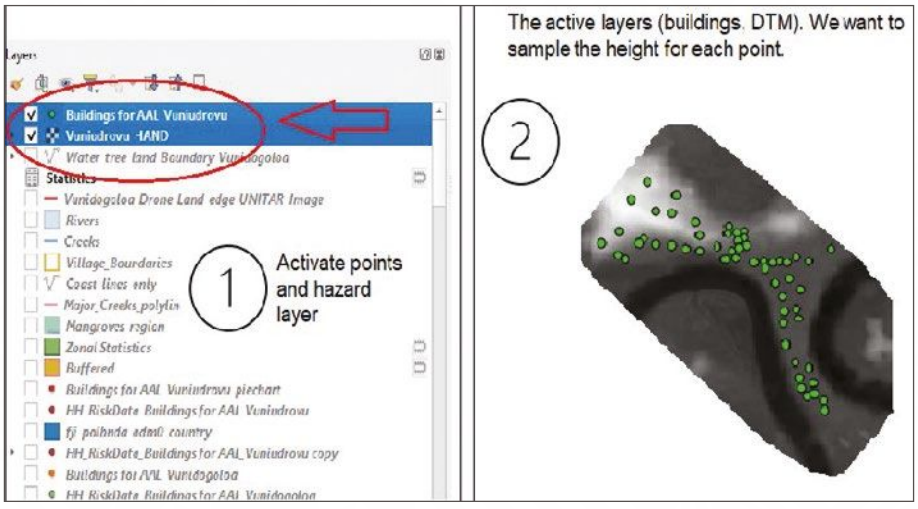
2.3 Sampling Hazard Data in QGIS

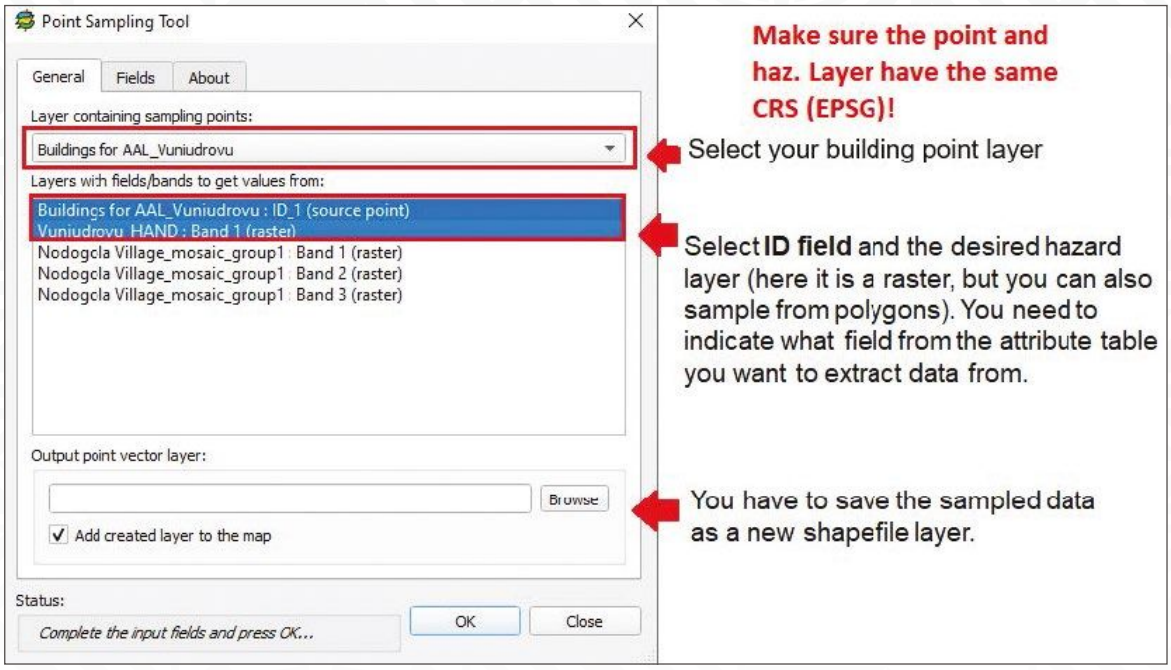
Now that the plugin is successfully installed, we will use it to connect your house vector points to the new HAND (Height Above Next Drainage) raster layer.

Data sampling is a critical step in the hazard assessment process. It acts as a bridge, permanently linking the values hidden inside your raster grid directly to the attribute table of your vector points. By running this process, you extract highly specific geographic risk information for the exact location of every single house centroid.

Pre-Processing Checklist:

- **Activate Your Layers:** Before opening the plugin, you must ensure that both your house vector point layer and the **new HAND raster layer are active** (checked) in your Layers panel.
- **Verify Visibility:** Making sure these two layers are actively selected guarantees they will show up as available inputs when you launch the plugin window.

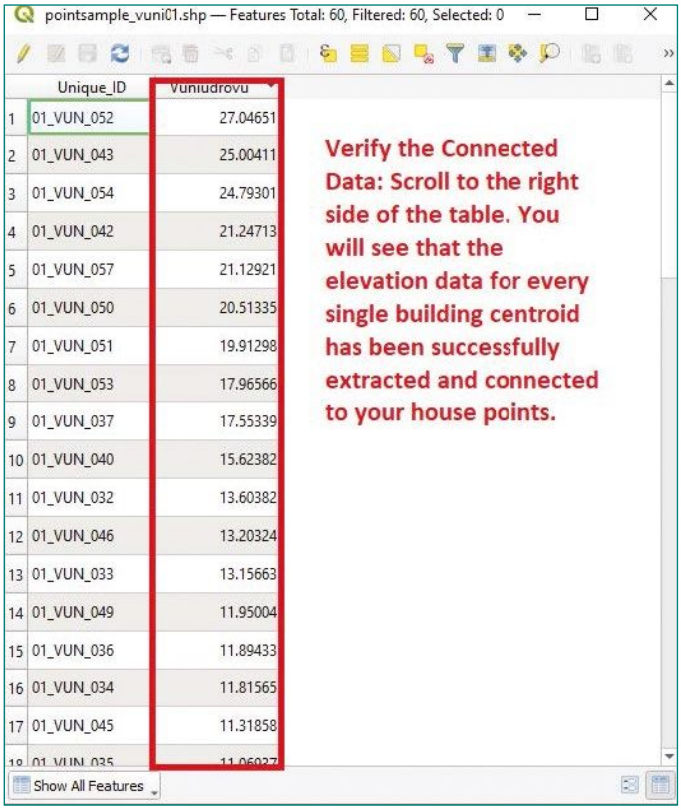




After running the tool, close the plugin window. Your newly saved shapefile will automatically appear as a brand-new layer in your Layers panel on the left side of the screen.

Now, we need to confirm that the tool successfully extracted the elevation data from the raster grid and attached it to your house dots.

Open the Attribute Table: Right-click the newly generated layer in your Layers panel and select Open Attribute Table.



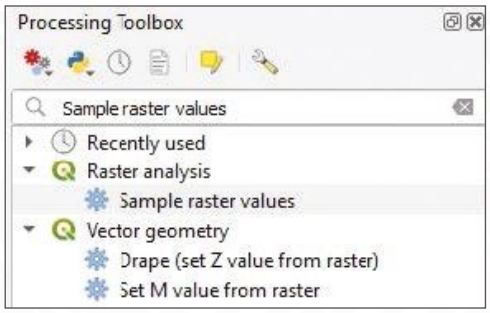
Phase 3: Merging Hazard Data with Asset Data

This step overlays the physical threat (raster) onto the community structures (vector) to measure exact exposure levels.

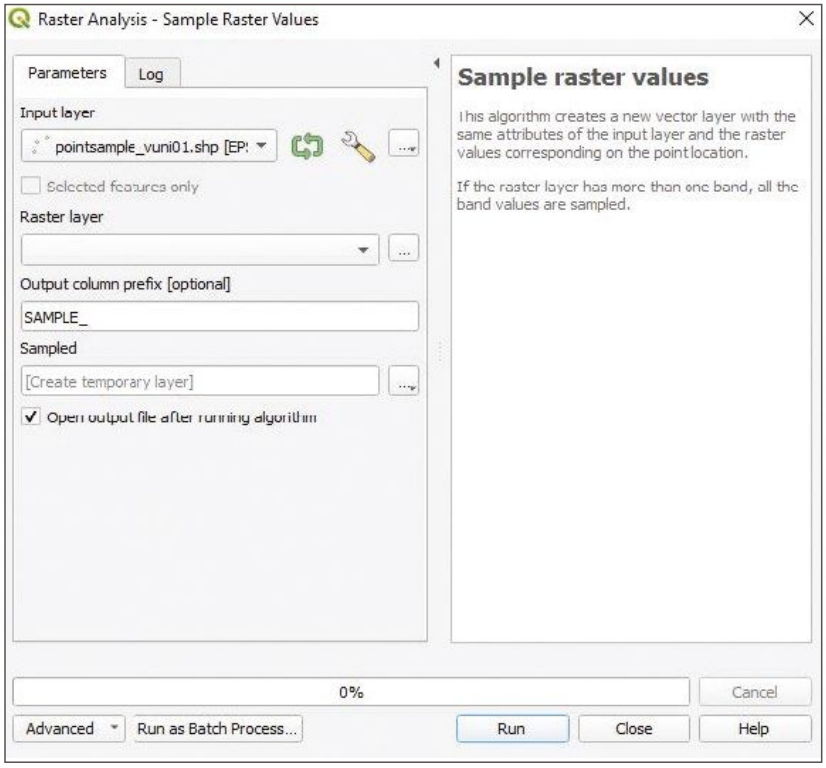
3.1 Running the "Sample Raster Values" Tool

This tool acts as a digital stamp, extracting the hazard grid data (e.g., water depth) and stamping it directly onto your building points.

1. Open the **Processing Toolbox** (top menu bar) and search for Sample raster values.

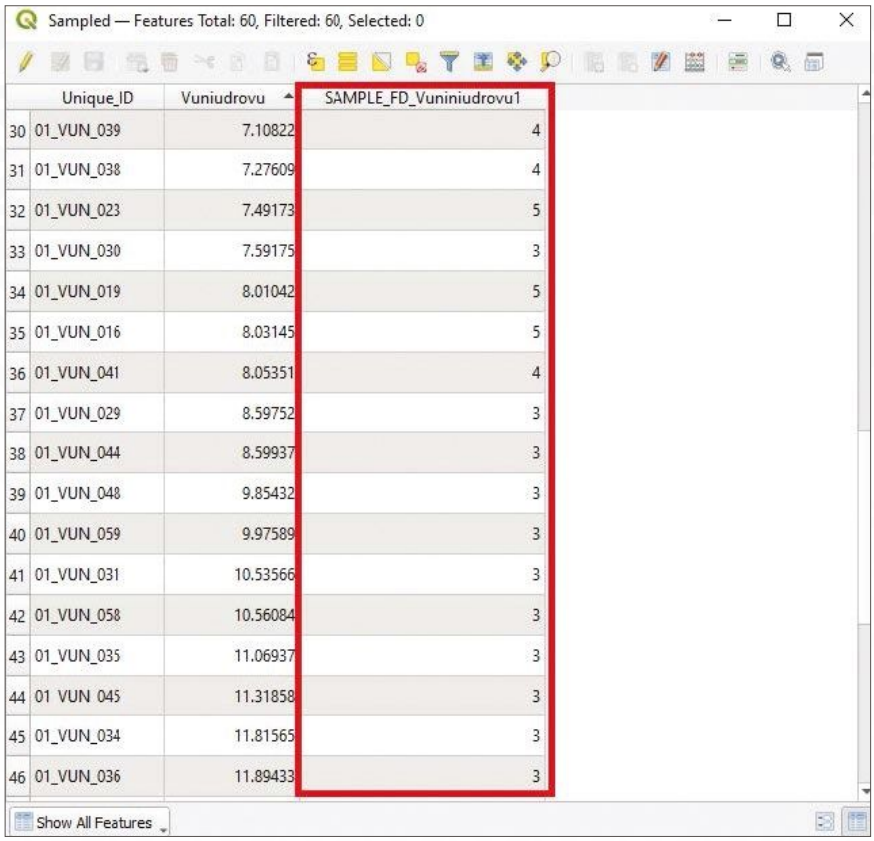


2. **Input Point Layer:** Select your building centroids layer (e.g., Vuniniudrovu_Houses).
3. **Raster Layer to sample:** Select your hazard raster (e.g., Flood_Depth_50yr).
4. **Output column prefix:** Type a clear identifier (e.g., Fl_50yr_ or Surge_).
5. Click **Run**. QGIS will generate a new temporary layer named Sampled Points.



3.2 Verifying the Data

1. Right-click the new Sampled Points layer and select Open Attribute Table.
2. Scroll to the right to verify the new column contains numerical depth/intensity values.
3. For River Floods: Use the Field Calculator to subtract the HAND_m value from the hazard depth value to determine the actual inundation depth inside the structure.



	Unique_ID	Vuniudrovu	SAMPLE_FD_Vuniniudrovu1
30	01_VUN_039	7.10822	4
31	01_VUN_038	7.27609	4
32	01_VUN_023	7.49173	5
33	01_VUN_030	7.59175	3
34	01_VUN_019	8.01042	5
35	01_VUN_016	8.03145	5
36	01_VUN_041	8.05351	4
37	01_VUN_029	8.59752	3
38	01_VUN_044	8.59937	3
39	01_VUN_048	9.85432	3
40	01_VUN_059	9.97589	3
41	01_VUN_031	10.53566	3
42	01_VUN_058	10.56084	3
43	01_VUN_035	11.06937	3
44	01 VUN 045	11.31858	3
45	01_VUN_034	11.81565	3
46	01_VUN_036	11.89433	3

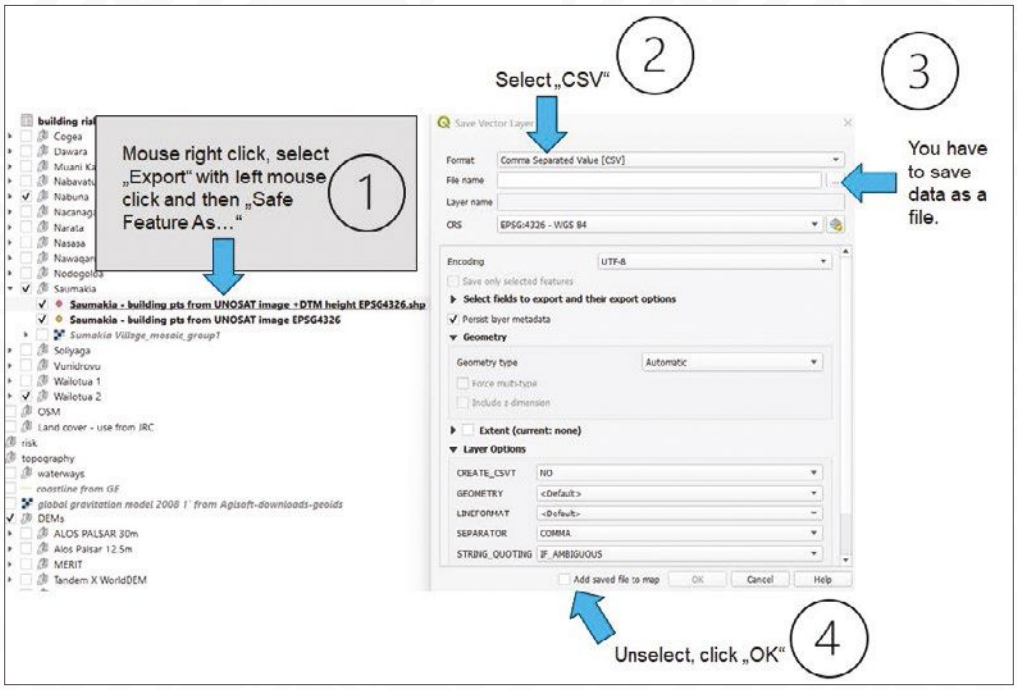
Troubleshooting Callout: If your new column is totally blank or says “NULL,” it means your house dots and your hazard map are not using the same CRS.

Phase 4: Calculating Damage and Generating Data Tables

This phase transitions your spatial processing (the map data) into numerical calculation. We will use probabilistic calculations to estimate expected physical damages and produce the final Average Annual Loss (AAL) and vulnerability metrics.

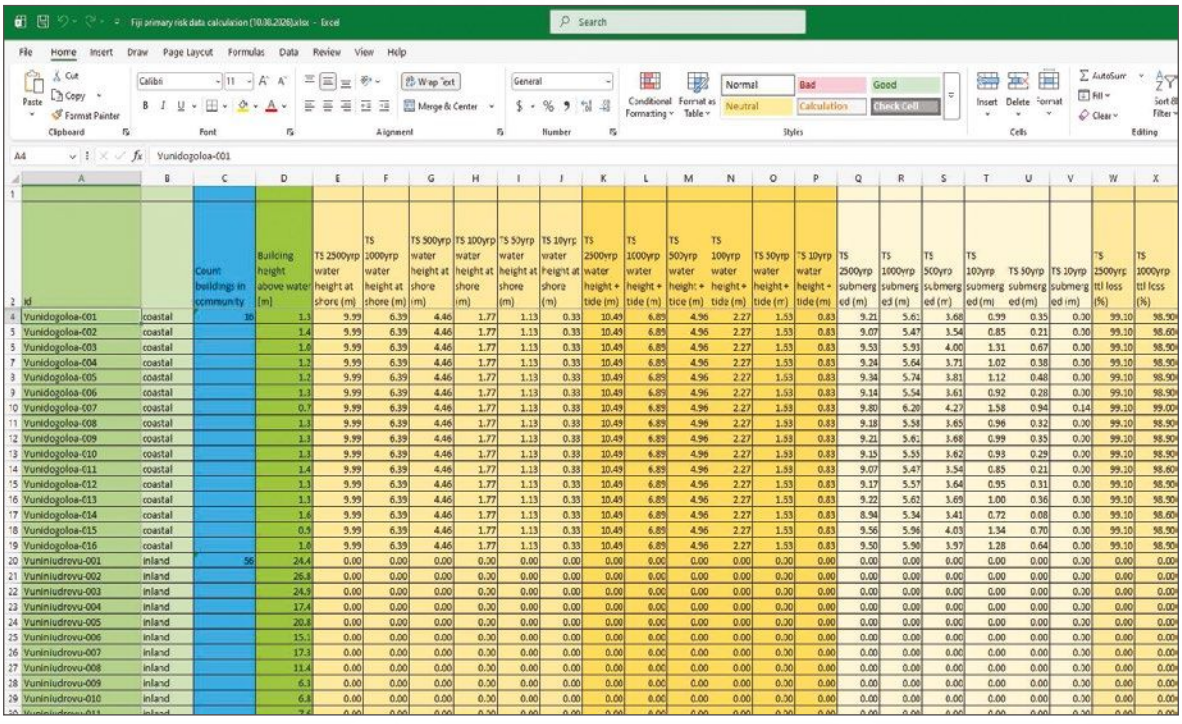
4.1 Exporting the Data

1. In QGIS, right-click the *Sampled Points* layer and select **Export > Save Features As.**
2. Choose **Comma Separated Value [CSV]** as the format.
3. Save the file in your **03_Outputs/Tables** folder and open it in Microsoft Excel.



4.2 Loading Data into the Primary Risk Calculator

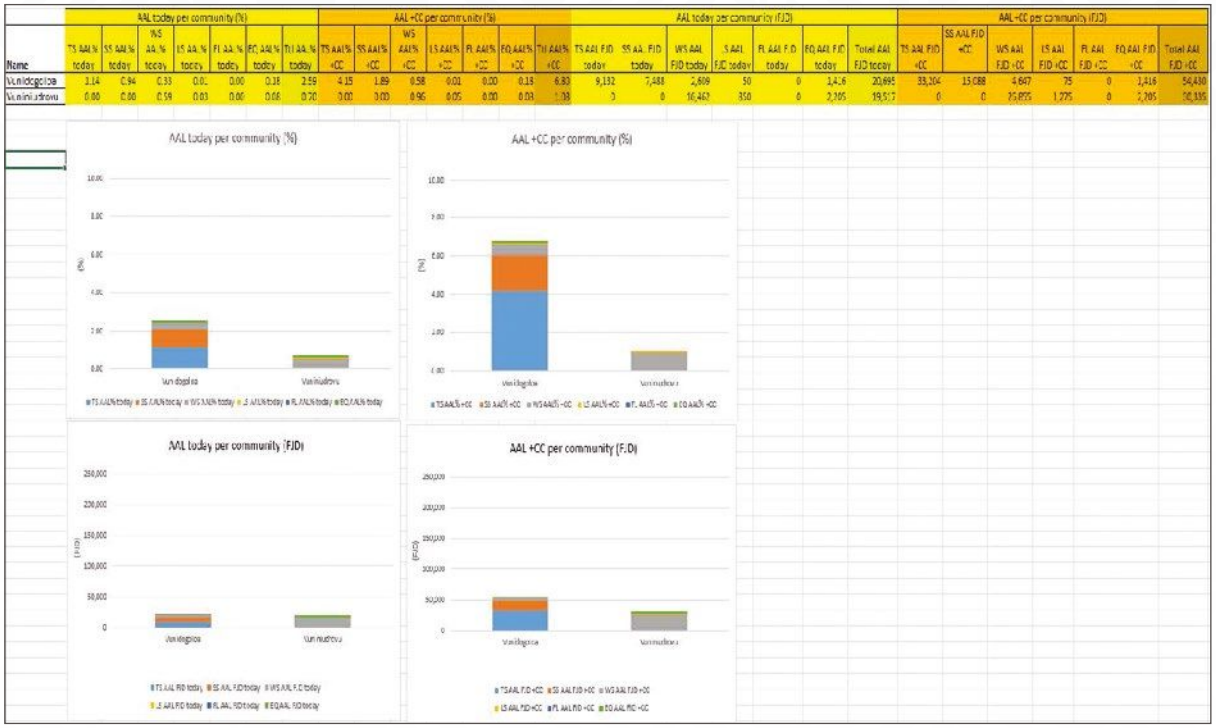
1. Locate and open the official reference workbook named exactly **"Fiji primary risk data calculation (10.08.2026).xlsx".**
2. Navigate to the **'Risk data'** sheet.
3. Copy your exported CSV data and paste it into this sheet. Ensure that every building is assigned to its own unique row, perfectly matching the Unique IDs generated in the previous mapping steps.



4.3 Calculating Expected Damages (AAL)

This methodology uses probabilistic calculations to determine expected damages. Internationally, the standard reference period is a single year, which gives us our Average Annual Loss (AAL).

1. **Per Building:** The Excel template calculates damages by factoring the specific vulnerability of an asset (e.g., the building's construction material) against the sampled hazard depth. The resulting damages are expressed as either the **percentage of the total asset value** (%), or in exact **monetary terms (FJD).**
2. **Per Community:** Open the 'Summary per community' sheet in the workbook. This file automatically aggregates the individual building data to pull community-wide statistics. This allows you to review the total risk profile for different hazards and compare impacts between different environments (e.g., riverine flooding in Vuniniudrovu versus coastal storm surges in Vunidogoloa).



4.4 Feeding Data Back to QGIS

After the calculations are finalized in Excel, this enriched risk data must be fed back into QGIS to create your visual deliverables.

1. Save your completed 'Risk data' sheet as a new CSV file.
2. Drag and drop this new CSV directly into your QGIS Layers panel.
3. Right-click your original house vector points layer and select Properties > Joins. Add a new join to link the CSV data to your map points using the building's Unique ID.

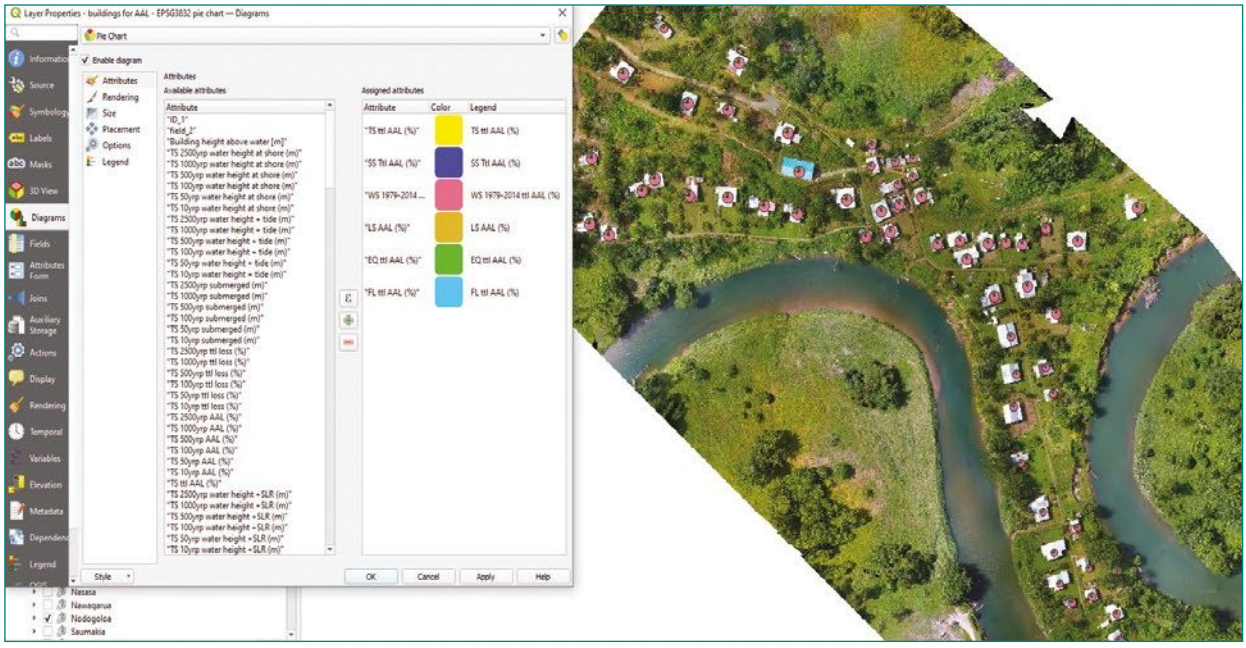
Phase 5: Generating Final Cartographic Maps

With the risk data linked back to your map, you will now produce the visual deliverables to communicate these spatial risks to stakeholders.

5.1 Setting Up Symbology (Using Data Diagrams)

To accurately reflect the precise, granular damage calculations performed in Excel, we will use QGIS diagrams rather than basic-coloured dots. Displaying the data using pie charts for individual buildings (or histograms for community-level aggregations) provides a highly localized and accurate visual output of the risk profile.

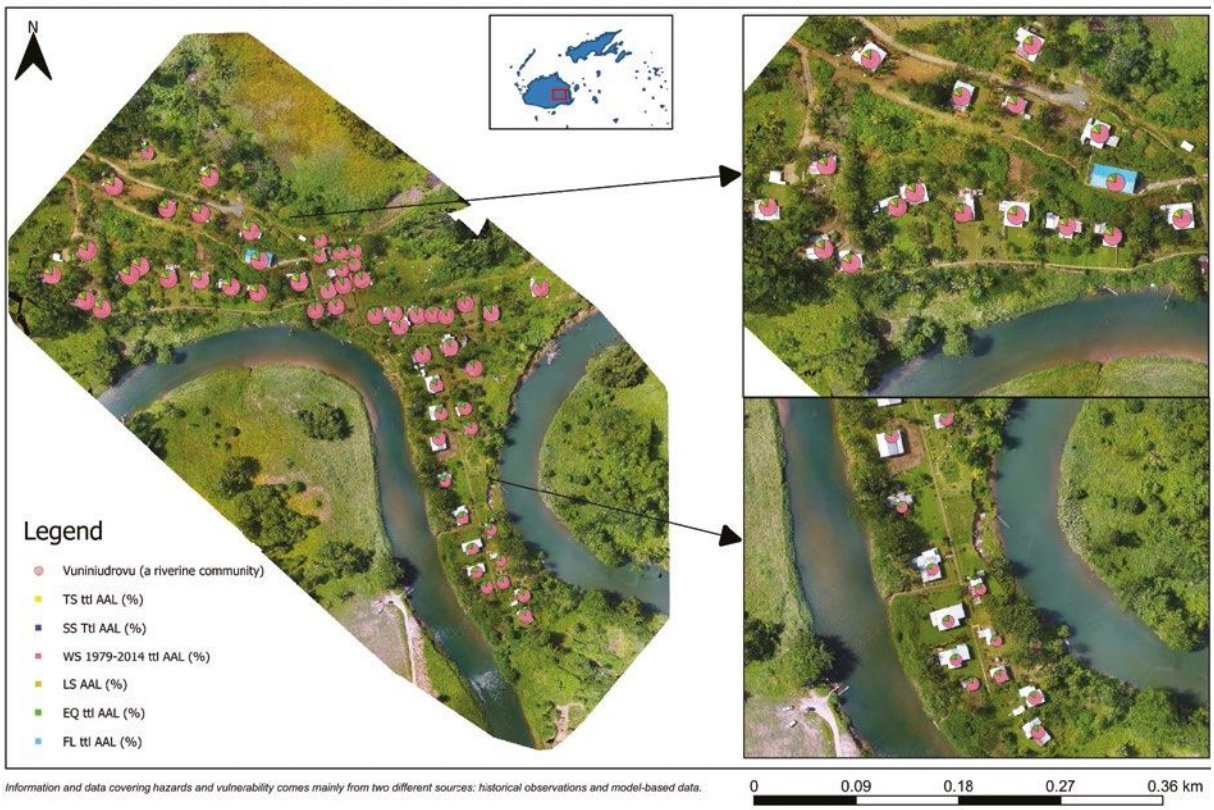
1. Return to the QGIS main window. Right-click your fully processed and joined building layer, select **Properties**, and navigate to the Diagrams tab (located just below Symbology on the left menu).
2. At the top of the window, change the drop-down menu from No Diagrams to **Pie Chart** (best for showing the damage vs. intact value of a specific building). *Note: If you are mapping aggregated community data, a Histogram may be preferred.*
3. Navigate to the Attributes sub-tab. Select your calculated Excel columns (e.g., **Expected_Damage_FJD** and **Remaining_Asset_Value_FJD**) from the list of available attributes and click the **+ (plus)** icon to add them to the "Assigned attributes" panel.
4. Color-code your assigned attributes logically by double-clicking the color box next to each one (e.g., Red for the damaged portion, Green for the intact portion).
5. Navigate to the **Size** and **Placement** sub-tabs to adjust how large the pie charts appear and ensure they sit neatly over your building centroids.
6. Click **Apply** and **OK.** Ensure your hazard grid layer is dragged beneath your building layer in the Layers panel, and adjust its transparency so the underlying satellite imagery remains visible.



5.2 Print Layout and Export

This final step formats your map into a professional document ready for the final report.

1. Open the top menu and select **Project > New Print Layout.** Give it a clear name.
2. In the new layout window, use the **Add Map** tool (on the left toolbar) to draw a box in the centre of the page. Your QGIS map canvas will appear inside it.
3. **Mandatory Map Elements:** You must use the layout toolbar to ensure every output map includes the following:
   - **A Descriptive Title:** Use the text tool to add a clear title (e.g., R*iverine Flood Exposure: 50-Year Climate Scenario).*
   - **A North Arrow and Scale Bar:** Essential for geographic reference.
   - **A Legend:** Add a legend that clearly defines both the hazard overlay (water depth) and the building risk colours.
4. Export the final layout by clicking **Layout > Export as PDF** (or Export as Image). Ensure the resolution is set to a minimum of **300 DPI** so the satellite imagery remains crisp.
5. Save the final file directly into your **03_Outputs/Maps** folder.



APPENDIX 2 Template for Assessing Adaptation Options

	GOALS				TIMING					ACCEPTABILITY		
Considerations	Efficiency	Effectiveness	Equity	Co-benefits	Urgency	Sustainability	Flexibility	Robustness	Practicality	Social	Cultural	Political
Option A:												
Option B:												
....												
Option D:												

STAPLEE Criteria	S (Social)		T (Technical)			A (Administrative)			P (Political)			L (Legal)			E (Economic)				E (Environment)				
Considerations → **for Alternative Actions ↓**	Community Acceptance	Effect on Segment of Population	Technical Feasibility	Long-term solution	Secondary Impacts	Staffing	Funding Allocated	Maintenance/Operations	Political Support	Local Champion	Public Support	State Authority	Existing Local Authority	Potential Legal Challenge	Benefit of Action	Cost of Action	Contributes to Economic Goals	Outside Funding Required	Effect on Land/Water	Effect on Endangered Species	Effect on HAZMAT/Waste Sites	Consistent with Community Environment Goals	Consistent with Federal Laws

APPENDIX 3 Indicators for Socio-Economic Vulnerability and Coping Capacity

	VULNERABILITY		
	Indicators	**Explanations of and rationale for including indicators**	**Sources providing support for including indicator (examples)**
Education	Portion of population above 15 years of age without primary (elementary school)	Many researchers believe that there is a connection between level of education and vulnerability, where the higher the education, the lower the vulnerability. This is partly ascribed to the positive correlation between education and income, but this relationship is not absolute. Notwithstanding, education is important for the ability to find and understand warning messages and advice from authorities (e.g., on self-help) in general.	Armenakis & Nirupuma (2013); Copeland, et al. (2020); Cutter et al. (2003); Fekete (2009); Garbutt et al (2015); Tate (2012); Ruiter et al. (2017); Tomaszewski et al. (2020)
Sector dependency	Portion of the community's livelihoods coming from the following sectors - farming - forestry - fishery - mining - tourism	Some economic sectors have been shown to be more vulnerable to natural hazards than others, including extractive industries (agriculture, forestry, fishing, the extraction of raw materials and tourism. Dependency on one type of income (not differentiated) increases vulnerability if disasters knock that source of income out.	Adger, W. et al. (2005); Amundsen, H. (2012); Cardona (2005); Cutter et al. (2010); Ruiter et al. (2017); Tate (2012), Yang et al. (2015)
Aid dependency	Public financial assistance for development per capita during the last two years	With aid dependency, the methodology points out the communities that lack sustainability in development growth due to e.g., economic instability or disasters.	INFORM incorporates the same indicator but for the national level and uses the public aid per capita and net official development assistance (ODA) received in percentage of gross national income (GNI) by the World Bank as bases for this.

VULNERABILITY			
	Indicators	**Explanations of and rationale for including indicators**	**Sources providing support for including indicator (examples)**
Household livelihood security	Portion of population below the national poverty line	Numerous studies correlate lack of financial means with vulnerability, where people with less means are more prone to reside in hazardous areas and in less sturdy homes, are less insured, and generally have less possibility to influence decisions that may affect their safety.	Armenakis & Nirupuma (2013); Cardona (2005); Cutter et al. (2003); de Brito et al. (2018); Fekete (2009); Garbutt et al. (2015); Liu & Li (2016); Marzi, et al. (2019); Ruiter et al (2017); Scherzer et al. (2019); Tate (2012); Tomaszewski et al. (2020); Yang et al (2015)
	Portion of adults (≥ 18 years) who do not have a full-time job	Employment generates purchasing power (which may be used to procure equipment and insurances to mitigate and prepare for disasters as well as pay for services during response). It also has a positive effect for developing networks and social cohesion, which in turn affects one's ability to seek and attain information about relevant measures to protect oneself.	Cardona (2005); Cutter et al. (2003, 2010); Fekete (2009); Garbutt et al. (2015); Holand & Lujala (2013); Ruiter et al., (2017); Scherzer et al. (2019); Tate (2012); Yang et al. (2015)
	Portion of adults (≥ 18 years) without health or property insurances	People with insurances have a lower financial vulnerability and better recovery ability than people who do not have insurance cover.	Adger et al. (2005); Cutter et al. (2010); Fekete (2009); Tomaszewski et al. (2020)
Housing	Portion of houses in community that are not built to withstand the natural hazards that the community faces	The structure, condition and materials of buildings are important for their vulnerability to stress and whether people can use them as shelters in the event of impending dangers (e.g., floods and storms)	Cutter et al. (2003, 2010, 2014); Fekete (2009); Holand & Lujala (2013); Tomaszewski et al. (2020); Van Zandt et al. (2012)
Displacement	Portion of households in community that experience displacement in the context of natural hazards	The magnitude, duration, and consequences of disaster displacement experiences faced by a community are important for understanding both vulnerability and adaptive capacity. Planned relocation can be a durable solution for people already displaced, or a strategy to avert or minimize future displacement. Displacement is defined as when person is forced to leave their homes or places of habitual residence.	IDMC (2023), PDD (2022)
Means of transportation	Portion of households without an own vehicle (e.g., car, boat, horse)	Facilitates evacuation and transportation of necessities to and from a disaster-stricken area	Burton (2015); Cutter et al. (2014); Scherzer et al. (2019)

	VULNERABILITY		
	Indicators	**Explanations of and rationale for including indicators**	**Sources providing support for including indicator (examples)**
Equality	Levels of income and assets are quite equal across households in the community	Income inequalities are linked to and can reinforce other inequalities such as education and health inequality. Unequal distributions of wealth have also the potential to create social unrest and violent crime, which in turn may undermine social cohesion and public trust in authorities (and their recommendations in relation to disaster risk management).	Adger et al. (2005); Becker (1968); Cobham et al. (2015); Cardona (2005); Cutter et al. (2010); Lindgren (2019); Ruiter et al. (2017)
	Girls and boys have equal access to education		INFORM incorporates gender inequality as a driver of socio-economic vulnerability and uses the GINI and Gender Inequality Index as bases for this. These indices in turn incorporate the indicators suggested here.
	There are as many women as men in decision making bodies in the community		(Same as above)
	Women and men have equal access to income generating activities		(Same as above)
Social capital	Population changes from migration (increase/ decrease) over the previous 10 years	Many researchers claim that large influxes of people into societies where "everyone previously knew everyone", change the dynamics and can make people no longer identify themselves as part of a cohesive group, which can make them withdraw and increase isolation and thus vulnerability. A massive influx of population can also overwhelm existing infrastructures, including a lack high-quality housing for newcomers.	Cardona (2005); Cutter et al. (2003, 2014); Fekete (2009); King & MacGregor (2000); Holand and Lujala (2013); Opach et al. (2020); UNOSAT Survey ("Adaptation study"); Vincent (2004)
	Portion of population who are part of communal activities (e.g., go to church or are engaged in other local organizations)	Social networks can provide informal safety and support during disasters and could also contribute to a faster recovery.	Cutter et al. (2010); Liu & Li (2016); Marzi et al. (2019); Scherzer et al. (2019); Tomaszewski et al. (2020);
	The community is characterized by a sense of unity, solidarity, and mutual trust between its members	It is well known that ordinary people (neighbours) - rather than emergency services - are the first responders in disasters. Social cohesion is a catalyst of solidarity and collaboration, which in turn are key for efficient response to and recovery from disasters.	Marzi, et al. (2019); Scherzer, et al. (2019)

VULNERABILITY			
	Indicators	**Explanations of and rationale for including indicators**	**Sources providing support for including indicator (examples)**
Awareness & skills	The community has experienced a disaster in recent times (within the last 20 years)	Previous experience from disasters and societal perturbations is expected to enhance resilience as decisionmakers and the public are expected to have an increased mental preparedness and rational perception of what preparedness measures that are relevant.	Cutter et al. (2010); Coulston & Deeny (2010); Feldmeyer, et al., 2019; Liu & Li (2016); Ruiter et al. (2017); Tomaszewski et al. (2020)
	Portion of population that are members of the Red Cross or another organization related to disaster management	High levels of organized and trained "disaster volunteers" increase the likelihood of the population understanding how to act in different types of disasters and take measures to prevent, prepare for and manage disasters.	Cutter et al. (2014); Liu & Li (2016); Tomaszewski et al. (2020)
	Portion of population that has received first-aid training or any other disaster related training	Increases the chance that neighbours (who often are the first responders) can assist each other, incl. saving lives, during disasters.	
	Community members are largely aware of the causes and implications of climate change, and the community has taken measures to reduce its negative effects (if so, what measures have been taken in response to the threat of climate change?)		
	Vulnerable groups	**Explanations of and rationale for including indicators**	**Sources providing support for including indicator (examples)**
Age	Portion of population >65 yrs & <5 yrs	The relationship between age and vulnerability is well documented. Usually, the youngest and eldest part of the population are considered the most vulnerable as they often are physically weak and less capable to fend for themselves in cases where physical strength is needed (e.g., when needing to run, climb or swim). As such, they are highly dependent on others (e.g., for movements to evacuation centres or for attaining and understanding information from authorities)	Adger et al (2005); Armenakis & Nirupuma (2013); Cardona & Carreño (2011); Cutter et al. (2003, 2010, 2014); Fekete (2009); Holand & Hulaja (2013); King & MacGregor (2000); Scherzer et al. (2019); Tate (2012); Tomaszewski et al. (2020)
Special needs	Portion of population with mental or physical disabilities	Disabled people are typically highly dependent on others (e.g., for movements to evacuation centres or for attaining and understanding information from authorities)	Cutter et al. (2010, 2014); Armenakis & Nirupuma (2013); de Brito et al. (2018); Fekete, (2009); Flanagan et al. (2011); Garbutt et al. (2015); Ríos Díaz (2018); Ruiter et al. (2017); Scherzer et al. (2019); Tate (2012); Tomaszewski et al. (2020); Yang et al. (2015)

	VULNERABILITY		
	Indicators	**Explanations of and rationale for including indicators**	**Sources providing support for including indicator (examples)**
Single-parent households	Portion male or female-headed households, no spouse present	Single-headed (especially female-headed) households have been found to be one of the most vulnerable groups of society that confront many problems and challenges, including low income and social isolation/ exclusion.	Blaikie et al. (1994), Cutter (2003); Morrow (1999)
Food insecurity	Portion of population without access to sufficient, safe, and nutritious food	Access to food is essential for people's energy and ability to respond to and recover after a disaster. Undernutrition undermines resilience since it impairs cognitive functions and reduces immunity to diseases.	Sphere standards (2018)
Health conditions	Portion of population who suffers from non-communicable diseases (NCDs)	People with NCDs are amongst the most vulnerable in the wake of disasters due to their continuous dependence on medicines and care in a situation when health systems' responsiveness are decreasing.	Ghazanchaei et al. (2021); Suneja et al. (2018)
	LACK OF COPING CAPACITY		
	Institutional	**Explanations of and rationale for including indicators**	**Sources providing support for including indicator (examples)**
Governance	Portion of population who has a "good" opinion of their Chief	Trust in the leadership makes it easier to organize preparedness and response efforts	
	People in this community experience that public officials are exercising their work in accordance with high ethical and professional standards		INFORM incorporates this indicator and basis it on Government effectiveness index (World Bank) and Corruption Perception Index (Transparency International)

	LACK OF COPING CAPACITY		
	Institutional	**Explanations of and rationale for including indicators**	**Sources providing support for including indicator (examples)**
DRR	Appropriate land use regulations and building codes exist or are disregarded by the community	Land-use regulations and building codes are the public's first line of defence against natural hazards	Coppola (2011, Ch. 5)
	The community has a disaster management committee (or similar) that regularly meets and actively try to reduce risks in the community	An agreed upon governing body for the management of disaster risks is instrumental for enhancing capacities to mitigate and respond to disasters	UNOSAT Survey ("Adaptation study")
	The community has earmarked funds for reducing or managing disasters	Financial means are often a prerequisite for mitigating and responding to disasters	Cutter et al. (2014); Coppola (2011, Ch. 5); UNOSAT Survey ("Adaptation study")
	The community has a satisfactory (clear, concise & updated) disaster management plan (developed or revised in the last 3 years)	A plan is useful insofar it clearly stipulates who is doing what, when and with what resources. Even so, there is seldom time to read the plan once a disaster has happened. Hence, the information in the plan must be "internalized" in the minds of community members already before disasters happens, which requires that it is periodically reviewed and exercised.	UNOSAT Survey ("Adaptation study"); Coppola (2011, Ch. 5)
	Community members are aware of the disaster management plan and its contents	(same as above)	UNOSAT Survey ("Adaptation study")
	There are routines in place for disseminating warnings about imminent threats and community members know how to act in response to such warnings	Warning systems provide citizens with awareness of an impending hazard event before it occurs, allowing them to prepare themselves fully or even avoid the hazard altogether	Tomaszewski et al. (2020)
	There are policies or agreements in place for the community to receive help from neighboring communities in case of disasters	Disasters often entail that local resources are insufficient and need to be supplemented by external assistance. Such help will be swifter and more appropriate if agreements have been enacted prior disasters concerning how such assistance may be requested, delivered, and funded.	Coppola (2011, Ch. 5)
	The community has recently (within the last 3 years) conducted disaster management exercises or risk awareness campaigns	Training and exercises are ways to improve disaster response	Cutter et al. (2014); Coppola (2011, Ch. 5)

LACK OF COPING CAPACITY			
	Infrastructure	**Explanations of and rationale for including indicators**	**Sources providing support for including indicator (examples)**
Communication	Portion of households without electricity	Access to electricity affects the possibilities to attain information about the disaster (e.g., advice on how to protect oneself) and communicate our needs to others.	Armenakis & Nirupuma (2013); Başaran-Uysal et al. (2014)
	Portion of population without access to Internet	Access to means of communication are key for attaining information about imminent threats and advice on how to act during disasters as well as for the possibility to communicate needs to stakeholders involved in the response.	Cutter et al. (2014); Marzi, et al. (2019); Scherzer, et al. (2019)
	Portion of adult population (≥ 18 years) without a mobile phone	(same as above)	Cutter et al. (2014); Marzi, et al. (2019); Scherzer, et al. (2019)
	The quality of telephone services within the community is good (Likert)	(same as above)	
	Portion of households with neither a radio or TV	(same as above)	
	Portion of adult population (≥ 18 years) that are not proficient English speakers	Since English is widely used in government, this indicator is indicative of the possibility of digesting/communicating information from/to authorities. This is important for the ability to understand what has happened and what one can do to protect oneself as well as to communicate one's own needs for help in the immediate aftermaths of disasters.	Armenakis & Nirupuma (2013); Cutter et al. (2010; 2014); Fekete (2009); Flanagan et al. (2011); Garbutt et al (2015); Holand & Lujala (2013); Tate (2012); Tomaszewski et al. (2020)
	Portion of population above 15 years of age that are illiterate	Important for the ability to find and understand warning messages and advice from authorities (e.g., on self-help) as well as communicate one's own needs.	Adger et al. (2005); Liu & Li (2016); Ruiter et al. (2017); Yang et al. (2015)
	Community members know how they can receive warnings about and advice on how to deal with disasters from authorities (Likert)	Knowing how to receive warnings and information on how to cope with disaster situations can help saving lives and act in a rational (informed) way during disasters	Coppola (2011, Ch. 5)

LACK OF COPING CAPACITY			
	Infrastructure	**Explanations of and rationale for including indicators**	**Sources providing support for including indicator (examples)**
Physical infrastructures	The community has ingress and egress routes that are useful (e.g. sturdy and wide enough) for evacuation as well as emergency services (Likert)	Possibilities of moving to and from the location of interest (here a community) are decisive for the speed with which people may evacuate and the supply of necessities to a community after an occurred event and, hence crucial for the response and recovery process	Burton (2015); Scherzer, et al. (2019); UNOSAT Survey ("Adaptation study")
	The community has good access (<500 m to pick up place) to public transportations every day	Facilitates evacuation and transportation of necessities to and from a disaster-stricken area	UNOSAT Survey ("Adaptation study")
	Portion of population without access to improved water source	Access to safe drinking water is vital for our survival and shortages affects our physical and mental abilities (resilience)	Başaran-Uysal et al. (2014); Dimova (2010); Sphere standards (2018); UNOSAT Survey ("Adaptation study");
	Portion of population without access to improved sanitation	People who lack access to toilets may defecate in the open and human excreta often contribute to spreading diseases in conjunction with floods	Sphere standards (2018)
	The community has a well-functioning sewage system and procedures for solid waste management (Likert)	A functioning sewage system is a prerequisite for an efficient and safe management of human excreta reducing the risk of illness from contaminated water sources. Untreated waste can pollute surface water and groundwater. Solid waste can block drainage systems, generating stagnant and polluted surface water, which can attract vectors such as mosquitoes and rodents.	Sphere standards (2018)
Protective infrastructure	The community is protected from natural hazards by man-made structures (e.g., sea walls, dikes, channels)	Man-made barriers may deflect the forces posed by natural hazards and thus reduce damages to people and community assets.	Coppola (2011, Ch. 4)
	The community has an accessible and satisfactory (e.g., sturdy with sufficient space and sanitation facilities) evacuation centre	Temporary shelters that are built in sturdy material at less hazard prone locations protect people from bad weather or danger	Cutter et al. (2014), UNOSAT Survey ("Adaptation study"); community visits (June 2022)
Green infrastructure	The community is protected from natural hazards by "natural barriers" (e.g., mangroves, vetiver grass, trees, topography, or wetlands that may serve as natural buffers against tsunamis, storm surges, intense winds, landslides and floods)	Natural barriers may deflect the forces posed by natural hazards and thus reduce damages to people and community assets	Burton (2015); Coppola (2011, Ch. 4); Feldmeyer, et al. (2019)

LACK OF COPING CAPACITY			
	Infrastructure	**Explanations of and rationale for including indicators**	**Sources providing support for including indicator (examples)**
Access to public safety & health	The community has a health clinic that can cater for most needs in normal times (non-disaster situations) (Likert)	Access to health care in the community reduces dependency on external help.	
	The community has a dispensary (pharmacy) that is well supplied for needs in normal times (non-disaster situations) (Likert)	Having access to medicines in the community reduces dependency on external help.	Cutter et al. (2014)
	Proximity to emergency services: a) Transportation time (min) from community to the closest hospital with surgery b) Transportation time (min) from community to closest the closest fire station? C) Transportation time (min) from community to closest police station	Proximity to risk reducing resources reduces vulnerability where the travel time to and from responding agents is an important factor.	Cutter et al. (2010); de Brito et al. (2018); Fekete (2009); Garbutt et al. (2015); Holand & Lujala (2013); Marzi, et al. (2019); Scherzer et al. (2019)
	% of budget allocated for emergency services (health services, fire- and police stations) in the municipality to which the community belongs	(same as above)	Adger et al. (2005); Cutter (2010); Ruiter et al. (2017); Vincent (2004)

Full references for sources as basis for indicators

Adger, W Neil, Brooks, Nick, Bentham, Graham, Agnew, Maureen, & Eriksen, Siri. (2005). *New indicators of vulnerability and adaptive capacity,* Tyndall Centre for Climate Change Research.

Amundsen, H. (2012). Illusions of Resilience? An Analysis of Community Responses to Change in Northern Norway. *Ecology and Society 17*(4): 46.

Armenakis, C., & Nirupama, N. (2013). Prioritization of disaster risk in a community using GIS. *Natural Hazards*, 66(1), 15-29.

Başaran-Uysal, A., Sezen, F., Özden, S., Karaca, O. (2014). Classification of residential areas according to physical vulnerability to natural hazards: A case study of Çanakkale, Turkey. *Disasters*, 38(1), 202-226.

Becker, G.S. (1968). Crime and Punishment: An Economical Approach. J*ournal of Political Economy,* 76(2), 169-217.

Blaikie, P., Cannon, T., Davis, I., Wisner, B. (1994). *At Risk: Natural Hazards, People's Vulnerability and Disasters.* Routledge, London.

Burton, C. (2015). A Validation of Metrics for Community Resilience to Natural Hazards and Disasters Using the Recovery from Hurricane Katrina as a Case Study. *Annals of the Association of American Geographers,* 105(1), 67-86.

Cardona, O.D. (2005). *Indicators of Disaster Risk and Risk Management: Program for Latin America and the Caribbean, Summary Report:* Inter-American Development Bank.

Cardona, O.D., & Carreño, M.L. (2011). Updating the indicators of disaster risk and risk management for the Americas. *IDRiM Journal, 1*(1), 27-47.

Cobham, A., Schlogl, L. & Sumner, A. (2015). *Inequality and the Tails: The Palma Proposition and Ratio Revisited,* DESA Working Paper No. 143. New York: United Nations.

Coppola, Damon P. (2011). *Introduction to International Disaster Management* (2nd ed.). Burlington, MA, USA: Butterworth-Heinemann.

Coulston, J.E., & Deeny, P. (2010). Prior exposure to major flooding increases individual preparedness in high-risk populations. *Prehospital and disaster medicine, 25*(4), 289-295.

Cutter, S.L., Boruff, B.J., & Shirley, W. L. (2003). Social Vulnerability to Environmental Hazards. Social Science Quarterly 84(1): 242-61.

Cutter, Susan L., Burton, Christopher G., & Emrich, Christopher T. (2010). Disaster Resilience Indicators for Benchmarking Baseline Conditions. *Journal of Homeland Security and Emergency Management, 7*(1), Article 51.

Cutter, S.L., Ash, K.D., & Emrich, C.T. (2014). The geographies of community disaster resilience. *Global Environmental Change, 29,* 65-77.

de Brito, M., Evers, M., Almoradie, S., & Delos, A. (2018). Participatory flood vulnerability assessment: a multi-criteria approach. *Hydrology & Earth System Sciences, 22*(1), 373–390.

Dimova, S. (2010). The role of geoinformation in disaster management, *Kartografija i Geoinformacije, 9*(14), 46-57.

Fekete, A. (2009). Validation of a social vulnerability index in context to river-floods in Germany. *Natural Hazards and Earth System Sciences, 9(*2), 393-403.

Feldmeyer, D., Wilden, D., Kind, C., Kaiser, T., Goldschmidt, R., Diller, C., & Birkmann, J. (2019). *Indicators for Monitoring Urban Climate Change Resilience and Adaptation. Sustainability, 11*(2931), 1-17.

Flanagan, Barry E, Gregory, Edward W, Hallisey, Elaine J, Heitgerd, Janet L, & Lewis, Brian. (2011). A social vulnerability index for disaster management. *Journal of Homeland Security and Emergency Management, 8*(1).

Garbutt, Kurtis, Ellul, Claire, & Fujiyama, Taku. (2015). Mapping social vulnerability to flood hazard in Norfolk, England. *Environmental Hazards, 14*(2), 156-186.

Ghazanchaei et al. (2021). Non-communicable diseases in disasters: a protocol for a systematic review, *J Inj Violence Res. 13*(1): 61-68.

Holand, I. S, & Lujala, P., (2013). Replicating and adapting an index of social vulnerability to a new context: a comparison study for Norway. *The Professional Geographer, 65*(2), 312-328.

King, David, & MacGregor, Colin. (2000). Using social indicators to measure community vulnerability to natural hazards. *Australian Journal of Emergency Management, 1*5(3), 52-57.

Lindgren, S. (2019). Income inequality and crime: Evidence from Sweden. Retrieved from: https://gupea.ub.gu.se/bitstream/2077/60835/1/gupea_2077_60835_1.pdf.

Liu, Delin, & Li, Yue. (2016). Social vulnerability of rural households to flood hazards in western mountainous regions of Henan province, China. *Natural Hazards and Earth System Sciences, 16*(5), 1123-1134.

Marzi, S., Mysiak, J., Essenfelder, A., Amadio, M., Giove, S., & Fekete, A. (2019). Constructing a comprehensive disaster resilience index: The case of Italy. *PLoS ONE 14*(9): 1-23.

Morrow, B. H. (1999). 'Identifying and Mapping Community Vulnerability. *Disasters, 23*(1):11–18.

Opach, T., Scherzer, S., Lujala, P., & Ketil Rød, J. (2020). Seeking commonalities of community resilience to natural hazards: A cluster analysis approach. *Norwegian Journal of Geography, 74*:3, 181-199.

Ríos Díaz, F., Marín Ferrer, M., Luoni, S. Antofie, T. E., Faiella, A. (2018). *Update of the DRMKC Loss database architecture for disaster risk management.* JRC Technical reports. Luxembourg: Publications Office of the European Union.

Ruiter, M. C. de, Ward, P. J., Daniell, J. E., & Aerts, J. CJH. (2017). A comparison of flood and earthquake vulnerability assessment indicators. *Natural Hazards and Earth System Sciences, 17*(7), 1231-1251.

Scherzer, S., Lujala, P., & Rød, J. K. (2019). A community resilience index for Norway: An adaptation of the Baseline Resilience Indicators for Communities (BRIC). *International Journal of Disaster Risk Reduction, 36*, 101107.

Sphere Project, Sphere Handbook 2018. Accessed December 7, 2022 from https://spherestandards.org/handbook-2018/

Suneja et al. (2018). *Chronic Disease After Natural Disasters: Public Health, Policy, and Provider Perspectives,* National Center for Disaster Preparedness, Columbia University Earth Institute, New York.

Tate, E. (2012). Social vulnerability indices: a comparative assessment using uncertainty and sensitivity analysis. *Natural Hazards, 63*(2), 325-347.

Tomaszewski, B.M, Moore, E.A., Parnell, K., Leader, A.M., Armington, W.R., Aponte, A., Brooks, L.... & Parody, R. (2020). Developing a geographic information capacity (GIC) profile for disaster risk management under United Nations framework commitments, *International Journal of Disaster Risk Reduction, 47.*

Van Zandt, S., Peacock, W. G., Henry, D. W., Grover, H., Highfield, W. E, & Brody, S. D. (2012). Mapping social vulnerability to enhance housing and neighborhood resilience. *Housing Policy Debate, 22*(1), 29-55.

Vincent, Katharine. (2004). C*reating an index of social vulnerability to climate change for Africa.* Tyndall Center for Climate Change Research. Working Paper, 56(41).

Yang, S., He, S., Du, J., & Sun, X. (2015). Screening of social vulnerability to natural hazards in China. *Natural Hazards, 76*(1), 1-18

APPENDIX 4 NELD Field Assessment Program

Day 1	Day 2	Day 3	Day 4	Day 5
Briefing for Assessment Team	**Community Introduction & Field Assessment**	**Field Assessment & Focus Group Discussion**	**Field Assessment & Focus Group Discussion**	**Debriefing**
- Introduction to overall CRVAM risk assessment tool - Training on NELD tool for community assessment - Review of NELD questionnaire - Review of community approach to ensure inclusive and participatory process among different vulnerable groups - Presentation on FPIC and consent processes process - Confirmation of field programme and responsible agencies	**AM** 1. Observe cultural protocol 2. Community awareness on SOP (steps that will be carried out and expectations) - a. mandatory consultation and consent processes b. Focus on the pre-stage and in-stage of planned relocation 3. Community consultation and consent process in the SOP. **PM:**4. Field assessment of the site as agreed on Day 1. 5. Household survey to be done concurrently Debrief of technical team	**AM - PM** 5. Community and household survey on: a. NELD including traditional knowledge and skills, traditional governance and structures, etc. b. Past and present existing skills and capacities (assets) c. Livelihood sources at new site d. Psychosocial aspects of moving to the new site (working from existing situation) e. Gender Debrief of technical team	**AM - PM** 6. Consent and expectations a. Revisit consent required b. Community consultations on expectations from the new site 7. Field assessment on – a. socio-economic aspects b. cultural assets and considerations Debrief of technical team	**AM** - Review of information gathered - Review of community feedback - Reporting and scores weighting process - Next steps **PM** - Suva team depart

APPENDIX 5 NELD Cultural Assets and Associated Activities

ASSET MEASURED	OBJECTIVE	TOOL / APPROACH
A. Physical aspects of Cultural Assets		
1. Traditional house mounds *(yavu)* / burial grounds and *sau tabu* / traditional groves	• Map yavu burial grounds and *sau tabu* / traditional g/roves at old site and any yavu/ burial grounds and *sau tabu* / traditional groves at new site • Information on age of the yavu/ burial grounds and sau tabu • Determine any hazards that the yavu burial grounds and *sau tabu* / traditional groves may be exposed to	**1. COMMUNITY MAPPING:** • Present the topo/mataqali boundary map and provide orientation to the community on how to read the map and the different location • ask community to map/mark any yavu/ burial grounds and *sau tabu* / traditional groves (Community MAP 1). Colour code and put in legend for all the symbols. • Number the yavu/ burial grounds and *sau tabu* / traditional groves and provide information (e,g. age, mataqali that the yavu belongs to, condition of the sites, hazards that place the sites at risk) • If possible, map the coordinates of the location of the yavu **2. SEMI-STRUCTURED INTERVIEW (SSI) / COMMUNITY MATRIX** – *can take place alongside mapping exercise* • Get perspective from men, from women and from elderly (i.e. interviews to be conducted in gender disaggregated groups) • How attached are they to the yavu/ burial grounds and *sau tabu* / traditional groves and how do they feel about moving away • Will they miss anything about these old sites when moving to the new site? • Why are some sites considered sacred/tabu? Any special trees, plants, animals, artefacts associated with the sites? • How important is it for the community to be connected to these sites? Did the displacement affect his connection? • How connected are the young people to these traditional sites? *Attached matrix to be drawn on large sheets of paper – wherever possible, the community to fill this in themselves* **3. FIELD VERIFICATION/TRANSECT WALK** • If possible, visit field sites to verify information and to GPS mark the sites **4. TEAM ASSESSMENT** • Review the information gathered and rate the following from 1 -5 (rating sheet attached)

2. Traditional houses at the old site *(bures)*	• Determine level of traditional knowledge and skills for constructing traditional house (factor in complexity/uniqueness of traditional design) • Determine traditional rites and protocols for constructing a traditional house • Assess existing traditional knowledge on where to source building materials • Determine community cohesion required for labour to build a traditional house	**1. COMMUNITY MAPPING** • Using same Community MAP 1 above, ask communities to mark the locations of any traditional bures that used to exist in their village (as far as they can remember) • Number the bures and provide information (age/year built, current condition (excellent - non-existing), type of bure, materials used and any special design **2. SSI & COMMUITY MATRIX** • Where did the materials come from? • How were the bures built – where did the labour come from and how were they organised? (traditional governance?) • How long did it take to build the bure and how many people • Were there any traditional protocols and rites to construct the bure? • If you need to build a bure at the new site, do you have the skills, traditional knowledge, resources, and labour to do so? • Do you think that having a bure is important for the village? (rating: no - good to have but not really important - very important) Explain • What would you consider as the main risks to preserving our traditional bure making skills? *Attached matrix to be drawn on large sheets of paper – wherever possible, the community to fill this in themselves* **3. FIELD VERIFICATION/TRANSECT WALK** • If possible, visit field sites to verify information and to GPS mark the sites **4. TEAM ASSESSMENT** • Review the information gathered and rate the following from 1 -5 *(rating sheet attached)*

ASSET MEASURED	OBJECTIVE	TOOL / APPROACH
3. Grounds used for subsistence or livelihood purposes *(ikanakana)*	• Determine main sites for food sources and livelihoods • Identify any changes that will take place with the relocation • Determine traditional knowledge and skills for navigation of specific places, ability to recognize landmarks or remember locations of healing herbs, trees, etc • Traditional knowledge and skills for identification of place-specific natural resources • Oral history of past fishing, hunting and gathering experiences in this specific place • Attachment to place	**1. COMMUNITY MAPPING** • Use map with contour / land use capability • Split into 2 groups = men and women **For old site** • Map out the different *kanakana* sites including any communal reserved land (for lotu or Vanua) • Identify how long the *kanakana* has been used • Identify the landowning unit, the users of the land and those who are granted access to the land • Identify main crops grown – which are sold, only for household consumption, or both • Mark areas for sourcing wild foods (plants, animals, fish) **For new site** • Map out the *kanakana* sites including any communal reserved land (for lotu or Vanua) • Identify the landowning unit, the users of the land and those who are granted access to the kanakana sites • Identify any traditional or formal agreements regarding the use of land for *kanakana* • Identify main crops to be grown – for income and subsistence • Mark any nearby areas for sourcing wild foods **2. SSI & COMMUNITY MATRIX** **For old site** • For the different kanakana, identify the landowning unit, other users of the land, and those who are granted access to the land • How long has the *kanakana* been provided? • Main crops grown – those that are sold, only for household consumption, or both • Will the same kanakana and other planting areas be still used when moving to the new site? • Determine traditional knowledge on sourcing wild foods, including knowledge of fruiting / flowering/harvesting season. How has this been affected since displacement? • Identify hazards that affect the kanakana and crop production • Identify any risks to traditional knowledge relating to food sourcing/preservation/ planting etc.

For new site

- Map out any new (or proposed) *kanakana* sites including any communal reserved land (for lotu or Vanua)
- Identify any traditional or formal agreements regarding the use of land for *kanakana* – landowners and land users
- Identify main crops to be grown at the new site – for income and subsistence
- In terms of food production, what are some changes that will occur when you move the new site
- Are there any new areas for sourcing wild foods at the new site?

Attached matrix to be drawn on large sheets of paper – wherever possible, the community to fill this in themselves

3. **FIELD ASSESSMENT & MAPPING:** (to be carried out with community reps, including woman)

For new site

- Assess the land use capability of the new site for sustainable agriculture and land use
- Map out area
- Determine any hazards that the sites may be exposed to and identify any other challenges relating to the establishment of sustainable agriculture and land use practices

4. **TEAM ASSESSMENT**
   - Review the information gathered and rate the following from 1 -5 *(rating sheet attached)*

ASSET MEASURED	OBJECTIVE	TOOL / APPROACH
B. Spiritual aspects of Cultural Assets		
4. Oral traditions and expressions & **5. Traditional rituals and protocols**	• Determine traditional knowledge of oral communications / chants • Determine traditional knowledge of ritual practices and ceremonies (e.g. various traditional practices for first born, visitors, first harvest, etc.) • Assess connection with ancestors • Determine attachment to place where oral traditions were developed and may specifically refer to	**1. SSI & COMMUNITY MATRIX** • Split to women and men groups • How many people know traditional oral communications (age group) • How many people know traditional chants (age group) • How many people are familiar with rituals (age group) • List the different chants and traditional practices and ritual that are still practiced and those that are no longer practised (why) • For existing chants / traditional practices, how often are these applied and when • How has this traditional knowledge been impacted by the displacement • Are there any climate or weather-related risks that are affecting these traditional knowledge? • Will existing traditional knowledge will be affected by the move to the new site (good and bad)? *Attached matrix to be drawn on large sheets of paper – wherever possible, the community to fill this in themselves* **2. TEAM ASSESSMENT** • Review the information gathered and rate the following from 1 -5 *(rating sheet attached)*
6. Traditional craftsmanship (e.g., tapa making; construction of canoes and wooden crafts; basket weaving)	• Determine the connection with cultural dimensions and practices of making crafts • Determine the relationship with place and resources to make crafts • Identify the specific protocols around cultural artifacts (iyau) that are specific for ceremonies like birth, transition, wedding or funeral	**1. SSI & COMMUNITY MATRIX** • Split into women and men groups • Assess types of traditional knowledge and crafts existing • What is the cultural importance/significance of making these crafts • Is there any economic value? Are they sold? Do you get paid to do this? • How long does it take to make the identified crafts • Are others taught how to make these crafts? Is this knowledge being passed on? • What are the traditional materials and tools used to make these crafts • How often are these crafts made? • Has there been a change over time (from old site to displaced site) with the making of these crafts? • Are there any climate or weather-related risks that are affecting traditional craftsmanship? • Will there be any change in traditional knowledge and craft making at the new site?

		Attached matrix to be drawn on large sheets of paper – wherever possible, the community to fill this in themselves **2. TEAM ASSESSMENT** • Review the information gathered and rate the following from 1 -5 (*rating sheet attached)*
C. Social aspects of cultural assets		
7. Traditional social structures, social bonds and cohesion between a community overall	• Determine cultural norm of connectedness of all people (e.g. solesolevaki) • Identify the strength of social safety nets, sense of security and stability, support systems (veiwekani) • Determine and cultural checks and balances as safeguards against violence (especially violence against women and girls) • The level of acceptance and sense of belonging among those married / located to the village	**If time - PARTICIPATORY SOCIAL NETWORK MAPPING** **Otherwise – SSI and MATRIX** • Split into women and men groups • List all social groups / community organisations at the current site. Identify the level of engagement / how active these groups are • Assess why some groups are more active than others • How has displacement (from old site to current site) affected the role of the different groups • What would be considered as the main social problems existing in the current sire • How important and effective are these groups in terms of – providing safety nets during times of crisis and difficulty, for counselling, for protecting women and girls, communal activities, community cohesion • What will be the impact of relocation on the various groups and on community cohesion • What are the key requirements for strengthening community cohesion and what are the main threats? *Attached matrix to be drawn on large sheets of paper – wherever possible, the community to fill this in themselves* **2. TEAM ASSESSMENT** • Review the information gathered and rate the following from 1 -5 (*rating sheet attached)*

APPENDIX 6 Fiji National Building Code (as link and QR code)



The Fiji National Building Code is a forward-thinking document that provides standards for strengths resilience, fire safety, health, amenity and sustainability for all building types. The requirements in this Code are intended to protect the public interest, be cost effective, straightforward to implement, easily understood and promote a sustainable and healthy built environment.

APPENDIX 7 Template Cost-Benefit Ana

Estimated Cost-Benefit Analysis for Binahaan FEW

	Historical costs													
Costs	Unit	Qty	Price/Unit [PhP]	Liveti me [yrs]	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Survey for installation	times	2	5,000		10,000.00									
Radio (handheld, cables)	pcs	3	7,000	12	1,750.00	1,750.00	1,750.00	1,750.00	1,750.00	1,750.00	1,750.00	1,750.00	1,750.00	1,750.00
Radio (base)	pcs	1	24,000	13	1,846.15	1,846.15	1,846.15	1,846.15	1,846.15	1,846.15	1,846.15	1,846.15	1,846.15	1,846.15
Sensor (water level, cables, solar panel), installation	unit	1	400,000	8	50,000.00	50,000.00	50,000.00	50,000.00	50,000.00	50,000.00	50,000.00	50,000.00	50,000.00	50,000.00
Sonsor (rain, cables, solar panel), installation	unit	1	275,000	13	21,153.85	21,153.85	21,153.85	21,153.85	21,153.85	21,153.85	21,153.85	21,153.85	21,153.85	21,153.85
Training on use of equipment	times	1	100,000		100,000.00									
Air conditioning	pcs	1	5,000	8	625.00	625.00	625.00	625.00	625.00	625.00	625.00	625.00	625.00	625.00
Desktop computers	pcs	2	20,000	3	13,333.33	13,333.33	13,333.33	13,333.33	13,333.33	13,333.33	13,333.33	13,333.33	13,333.33	13,333.33
Desks	pcs	2	7,000	10	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00
Chairs	pcs	6	900	10	540.00	540.00	540.00	540.00	540.00	540.00	540.00	540.00	540.00	540.00
Cabinets	pcs	2	11,000	10	2,200.00	2,200.00	2,200.00	2,200.00	2,200.00	2,200.00	2,200.00	2,200.00	2,200.00	2,200.00
Weather station	pcs	1	165,000	10	16,500.00	16,500.00	16,500.00	16,500.00	16,500.00	16,500.00	16,500.00	16,500.00	16,500.00	16,500.00
Manual river level gauge	pcs	3	1,000	0.5	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00
Building or room					3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00
Electricity, water, salaries, transport					600,000.00	600,000.00	600,000.00	600,000.00	600,000.00	600,000.00	600,000.00	600,000.00	600,000.00	600,000.00
Total Costs					***828,348.33***	***718,348.33***	***718,348.33***	***718,348.33***	***718,348.33***	***718,348.33***	***718,348.33***	***718,348.33***	***718,348.33***	***718,348.33***
Benefits														
Reduction of damages of movable items by EWS					500,000.00	525,000.00	551,250.00	578,812.50	607,753.13	638,140.78	670,047.82	703,550.21	738,727.72	775,664.11
Total Benefits					***500,000.00***	***525,000.00***	***551,250.00***	***578,812.50***	***607,753.13***	***638,140.78***	***670,047.82***	***703,550.21***	***738,727.72***	***775,664.11***
Net Returns					-328,348.33	-193,348.33	-167,098.33	-139,535.83	-110,595.21	-80,207.55	-48,300.51	-14,798.12	20,379.39	57,315.77
Benefit-Cost-Ratio					0.60	0.73	0.77	0.81	0.85	0.89	0.93	0.98	1.03	1.08

Assumptions

Average annual damages of moveable items

Reduction of damages of moveable items by EWS by 50%

Notes

BCR: must be greater than 1 to be in net earnings area.

Break even after 8 years

NOTES

NOTES

NOTES


Kerēvaka na Kalou ka doka na Tui