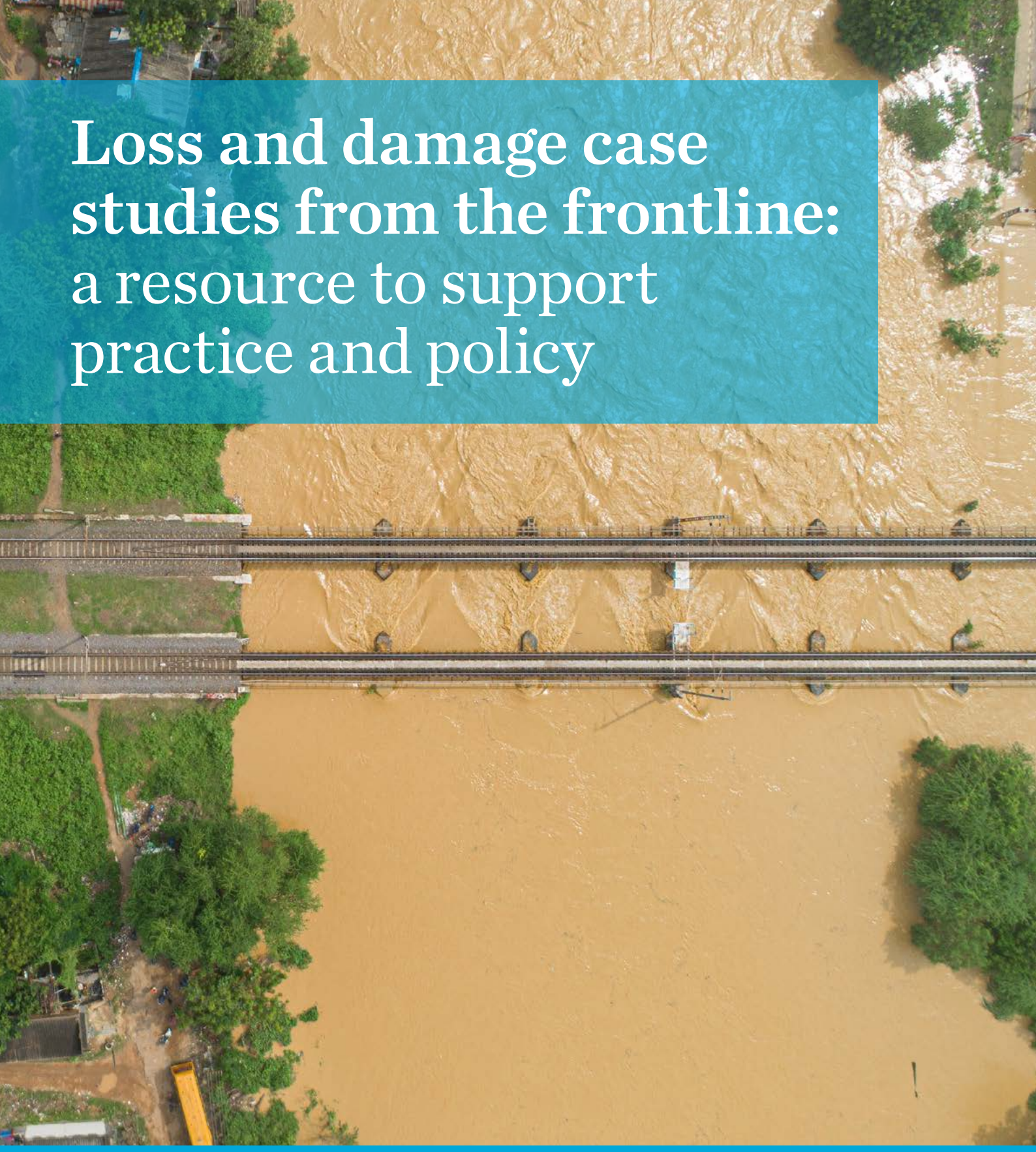
Loss and damage case studies from the frontline: a resource to support practice and policy



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ICCCAD
International Centre for Climate Change and Development

About this resource

Loss and damage caused by climate change is an urgent issue. To support evidence-based action, IIED and ICCCAD present 12 case studies from diverse locations experiencing slow- and rapid-onset climate events. Each case study details the challenges, possible responses and support needed to address loss and damage. Individually, they offer transferable lessons on effective response; taken together, they capture the bigger picture and highlight the universal need for support. This resource will aid both stakeholders from climate-vulnerable countries looking for practical solutions and advocates seeking evidence to inform international and national policy discourse.

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Published by IIED, October 2021
Bharadwaj, R and Shakya, C (eds) (2021) Loss and damage case studies from the frontline: a resource to support practice and policy. IIED, London.
ISBN: 978-1-78431-928-1
http://pubs.iied.org/20551iied

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Front cover photo: flood water near Eluru railway station, India. Flooding can damage local infrastructure
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Back cover photo: dry lake during drought in Burkina Faso. More intense dry seasons can lead to severe water shortages
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Foreword

Climate change is already having a devastating impact on the lives and livelihoods of millions of people around the world and its effects are building in force and frequency. From floods and hurricanes, to wildfires and famine. And it is a gross injustice that those that have done the least to cause the problem suffer most from its effects, whether that is climate-vulnerable countries or historically marginalised groups.

The loss and damage resulting from climate impacts can have a lasting impact, as I saw on Barbuda, which is still recovering from Hurricane Irma four years on. Such impacts can overwhelm countries' efforts to deal with climate change, ruin lives and wreck livelihoods.

It is clear that global action on climate change must include responding to loss and damage. And that response must consider not only the type of threat and geography, but who is affected. This requires a full understanding of loss and damage, informed by those who know.

So I welcome this collection of case studies. As we approach COP26, it provides practical knowledge from countries on the frontlines of climate change on risks, responses and resources. The case studies will help to inform discussions on this vital issue at the critical COP26 summit and beyond.



The Rt Hon Alok Sharma MP
COP President Designate

Foreword

Loss and damage from human-induced climate change is an emerging issue, as the adverse impacts of climate change are becoming more and more visible around the world, ranging from more severe cyclones to super wildfires and frequent floods, as well as heatwaves and droughts. Better risk reduction methods mean we can now save people's lives, but the devastation to homes, agriculture and infrastructure caused by climate change-induced disasters leave people in disarray and displaced for long periods.

The important issue is that loss and damage from human-induced climate change is different from adaptation; its impacts exceed the adaptive capacity of countries, communities and ecosystems. It deserves to be addressed at the United Nations Framework Convention on Climate Change (UNFCCC) negotiations. However, the issue of how to tackle loss and damage from climate change has been a very contentious one at the UNFCCC for many years. It is, therefore, of paramount importance to the most vulnerable developing countries that loss and damage from human-induced climate change is addressed at COP26 when it is held in Glasgow, Scotland in November 2021.

The Government of Bangladesh has an important role to play: the Honorable Prime Minister Sheikh Hasina is the current chair of the Climate Vulnerable Forum (CVF), a high-level political forum of nearly 50 of the most vulnerable developing countries. The CVF has recently decided to push for a political outcome on loss and damage at COP26, particularly on funding beyond adaptation and even insurance. With a leadership that involves 48 heads of government, the CVF is paving a path towards strong political leverage of the loss and damage agenda. Prime Minister Sheikh Hasina's declaration that loss and damage is key to the CVF agenda demonstrates Bangladesh's leadership in bringing this issue to the urgent attention of the UK COP presidency. In November, the CVF aims to speak as one common voice on loss and damage, strongly stating that it is a make-or-break issue for the summit.

The scientific community has already given its verdict: the growing intensity of disasters are now attributable to human-induced climate change, as the global mean temperature has risen by more than one degree Celsius due to our greenhouse gas emissions. So, while we need to redouble our efforts to reduce emissions and also to adapt to the impacts of climate change, it is now the time to deal with loss and damage from human-induced climate change proactively to minimise the long-term adverse impacts that vulnerable communities face, which often go unobserved.



Prof Dr Saleemul Huq
Director of the International Centre for Climate Change and Development (ICCCAD)

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A note on methodology

IIED and ICCCAD recognise that the real experts in loss and damage (L&D) are the people and practitioners already anticipating, managing and supporting recovery from climate impacts affecting their communities. It follows that the process for developing the case studies in this toolkit had to be owned by stakeholders from vulnerable countries.

A co-development approach

IIED and ICCCAD issued a call for abstracts from stakeholders in countries already working with L&D. Of 38 responses, 12 were shortlisted for further development, based on assessment by a group of eight project mentors — all experts in L&D and working in the global South, with the exception of one European specialist. The selection criteria included: range of impacts, diverse geographies, analysis of issues faced by vulnerable groups, inclusion of current coping mechanisms and suggestions for future interventions.

A South-South capacity building and mentoring approach was developed to link the shortlisted authors — comprising civil society organisations, local experts, university-based researchers and NGOs — to L&D experts in countries facing similar crises to their own. The approach was collaborative and designed to support each author's self-learning. Through a series of training and consultation sessions, the mentors worked with the authors to:

1. Create an understanding of key concepts and definitions used in L&D discourse
2. Capture the local issues, challenges and recommendations through creative expression and effective writing, and
3. Provide individual support through an iterative process of case study development, offering feedback and guidance at various drafting stages until the case study was finalised.

IIED and ICCCAD established and facilitated this process, by:

- Bringing together important stakeholders from vulnerable developing countries (communities, CSOs and NGOs) with advocates and experts on L&D; creating an awareness of the need to generate local evidence and a knowledge base, draw learning from them, and come up with local solutions.
- Supplying background materials and technical support to create an understanding of the conceptual aspects of L&D and the framing of its risks.
- Creating a space for vulnerable developing countries and communities to tell their stories about L&D, communicate their priorities for action, and share their solutions.
- Enabling South-South collaborative learning, support and sharing experiences of L&D issues. With sustained support, this enabled the co-generation of a critical mass of compelling knowledge and evidence, which can support representatives of vulnerable developing countries and communities to raise the priority of L&D in international and national policy discourse.

The mentors

Special acknowledgement is due to the experts who generously shared not only their considerable knowledge of L&D, but on the process of developing a robust evidence base and writing for impact. In alphabetical order, sincere thanks to:

Istiakh Ahmed, Bangladesh
Senior program coordinator (Locally Led Adaptation and Resilience; Loss and Damage), the International Centre for Climate Change and Development (ICCCAD)

Sumaiya Binte Anwar, Bangladesh
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Devanshu Chakarvarti, India
Climate resilience, social protection and loss and damage expert

Kees van der Geest, the Netherlands
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Dr Somnath Hazra, India
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Introduction

Loss and damage is an urgent concern, driven by the increasingly harmful effects of climate change. Many countries are experiencing new types and forms of climate impact, of higher intensity, which they are not equipped to handle. These impacts are increasingly falling into the category of 'loss and damage' (L&D),[1] as the capacity of affected communities and countries are compromised to such an extent that they are no longer able to absorb the effects of climate risks or adapt to climate impacts.

In 2017, the Caribbean faced three Category 5 hurricanes — an unprecedented series of events. In some countries, the damage caused exceeded the annual GDP. In the wake of Cyclone Harold, which made landfall in Vanuatu in 2020, the economic loss and damage was estimated at more than US$440 million. Cyclone Ana hit Fiji in January 2021, just a month after Cyclone Yasa struck the country's northern islands. Ana left 10,000 people homeless and caused widespread damage to both infrastructure and crops.[2]

Beyond the direct loss of lives, livelihoods, assets and infrastructure, loss and damage also has secondary and tertiary consequences. For example, in Caribbean countries L&D has limited the delivery of essential services, causing long-term impacts on the health and education of young people. In some countries L&D is having far-reaching effects on mental health, wellbeing and social structures: climate shocks expose women, girls and people living with disabilities to new forms of exploitation, slavery and trafficking. In Barbados, for instance, people with little social or economic protection are suffering mental trauma and anxiety due to incessant rains and recurring shocks.[3] In Ghana, young women and children forced to migrate by climate impacts face being coerced into situations of debt bondage and slavery by agents who run *kayayie* (head-carrying manual labourers/porters).[4] Planning for, responding to and recovering from such unprecedented events are not just beyond the national budgets of affected countries, but also often exceed the current knowledge, skills and capacity of governments, civil society and communities. Effective responses may also require new knowledge and skills where radical interventions such as planned relocation or changing the livelihoods base need to be considered.

Loss and damage is happening now. We urgently need to develop new approaches or build on existing ones to manage the more diverse climate risks countries and communities are facing, and those they expect to face in the future. However, L&D issues cannot be adequately addressed unless we understand them clearly and use that knowledge to inform decision making and financing.

1 Climate change loss and damage does not have a universally agreed definition. Some countries frame L&D as residual risk when mitigation is insufficient and when the full potential of adaptation is not met, while others frame it as the residual losses and damages after mitigation and adaptation choices have been made. Another concept of L&D is that of 'adaptation limits'. According to the IPCC, adaptation limits are reached when adaptation is no longer able to "provide an acceptable level of security from risks to the existing objectives and values and prevent the loss of the key attributes, components or services of ecosystem."

2 Heinrich Boll Stiftung et al. (2021) *Unpacking finance for loss and damage: Why do developing countries need support to address loss and damage?* Washington, DC: Heinrich Boll Stiftung North. https://us.boell.org/en/2021/04/06/why-do-developing-countries-need-support-address-loss-and-damage

3 Bharadwaj, R, Gallagher, C, Carthy, A, Nisi, N, Shakya, C and Addison, S (2021). Climate change loss and damage: 1st deliberative dialogue report. IIED, London. https://pubs.iied.org/20346iied

4 Bharadwaj, R, Bishop, D, Hazra, S, Pufaa, E and Kofi Annan, J (2021) *Climate-induced migration and modern slavery: a toolkit for policymakers. IIED, London Anti-Slavery* International, London https://pubs.iied.org/20441g

IIED and ICCCAD have created this unique set of case studies to fill critical knowledge gaps: taken together, they form a 'toolkit' of examples and information to draw on. The content will help vulnerable countries to understand and express the L&D risks they face, across diverse contexts, as well as learn about existing coping mechanisms and strategies that can be viable in tackling L&D based on the existing thresholds of tolerable risk of different countries and communities. The case studies also represent a knowledge base that can be used to influence national and international policy discourse on action and support needed to tackle L&D at local level.

Limitations of international policy discourse on loss and damage

The international policy debate on L&D began more than three decades ago, alongside the establishment of the United Nations Framework Convention on Climate Change (UNFCCC) in the early 1990s. Discussions were formally institutionalised under the UNFCCC through the Warsaw International Mechanism (WIM) on Loss and Damage, adopted in 2013, and given firm consideration in the Paris Agreement in 2015. The WIM was tasked with addressing L&D associated with impacts of climate change by enhancing:

- Knowledge generation
- Coordination, and
- The provision of technical support to vulnerable countries.

In 2019, the Santiago Network on Loss and Damage (SNLD) was created at COP25 to support the work of WIM by catalysing access to and organising the availability of technical assistance to climate-vulnerable developing countries.

In 2021, as we approach COP26, these case studies from the climate frontline seek to inform efforts to set up the coordination mechanism to collate and understand L&D risks, and to generate means for addressing it at local level, where the effects are truly felt.

Recognising the knowledge gaps around loss and damage

While there has been a welcome increase in literature and evidence focused on L&D, there are still major knowledge gaps. The reasons for this are:

1. Most research has been theoretical, focused on conceptualisations of L&D from a variety of perspectives and links to other policy frameworks, with significantly less empirical research
2. Limited evidence originating from the global South, which has a critical role in framing how support should be given, and developing delivery and financing mechanism for L&D
3. The complexity and context-dependent nature of L&D presents a challenge to top-down thinking, which is more adept at 'one-size-fits-all' solutions.

L&D occurs where a particular society reaches it adaptation limits; where adaptation has not been implemented optimally (perhaps because the actions are unaffordable, not physically or technically possible, or socially difficult); or indeed where an adaptation measure was simply not done in time due to limited capacity or finance. This means that L&D responses **must** differentiate according to the local context.

While adaptation actions play an important role in reducing the impact of climate change experienced by communities, L&D is ultimately governed by the complex multidimensional factors that determine how vulnerable individuals, households, communities and regions are to climate impacts. These factors include: physical exposure to climate hazards over time; the rate and type of economic development; ecosystem health and biodiversity; poverty levels; social and economic inequalities; the state of institutions and governance arrangements; quality of infrastructure; access to essential services and others.

Effectively addressing L&D across the wide range of national and local contexts where it may occur urgently requires that national governments, NGOs, CSOs, and those who engage in national and international policy discourse and negotiations on L&D, better understand:

- **How L&D is currently impacting communities** — and the vulnerable groups within them — across the varied landscapes of the LDCs and SIDS, so that a diverse range of solutions can be developed to address those risks.
- **Which approaches and practices are most effective** in tackling different forms of L&D risk in any given context. This evidence can both support thinking about how L&D support should be designed and enable a deeper understanding of the available options at climate negotiations.
- **What resources (technology, finance and capacity) will be needed** to adequately respond to the range of L&D impacts, particularly where the limits to adaptation are forcing consideration of more radical responses, such as relocation or rehabilitation. Considerations must include how to deliver these resources in a way that they reach the most vulnerable countries and communities in time for both rapid and slow onset events that need a range of responses — anticipatory action, humanitarian support, rehabilitation and recovery support and so on.

How this resource can help create the necessary understanding is described below.

Tackling the challenges of loss and damage: how to use the case studies

This collection of case studies has been created primarily for stakeholders from climate-vulnerable countries looking for practical solutions to L&D impacts and for policy advocates seeking evidence to inform the international and national policy discourse. It is designed to: address the current knowledge gaps around L&D; create a picture of the current L&D risks and responses; and to suggest how this evidence can be used to inform L&D discourse and action at multiple levels.

Closing the knowledge gaps: emerging insights from the global South

The case studies presented here are a vital resource, providing some of the much-needed insight into vulnerabilities and existing coping strategies at local level. They cover diverse geographic regions and illustrate a range of climate risks. Each case study was co-developed with partners from civil society, local experts, university researchers and NGOs, using an iterative, collaborative and bottom-up approach to gathering evidence (read more about the methodology on page 6).

The case studies unpack the realities of local experience of L&D. Using primary and secondary data and local knowledge, they provide grounded evidence on the challenges, possible responses and resources needed to tackle L&D risks. Understanding the local impacts, particularly on social systems and access to resources and services, can serve as a foundation for improved policy formulation and for setting up adequate institutional mechanisms to address climate-induced L&D in an anticipatory, agile and responsive manner.

Together, the case studies:

1. Illustrate the L&D impacts of climate change-related hazards such as droughts, floods, soil degradation, glacier melt, sea level rise, salination, coastal erosion and biodiversity loss
2. Explain the various L&D impacts these climate hazards are having on the lives, living conditions and livelihoods across a range of types of vulnerable people and on the ecosystems and infrastructure they depend on
3. Highlight how L&D impacts compound or exacerbate other risks (such as poverty, health, marginalisation, conflict and so on)
4. Explain the impacts L&D is having at the level of community and society (such as on access to basic services and institutions, population displacement or migration, loss of customs, places of ritual, cultural heritage)

5. Illustrate the coping and adaptation measures — both traditional and innovative — that are being employed by households and communities to address, minimise or avert L&D risks
6. Highlight the existing gaps and challenges, and what needs to be done to help the communities to prepare, cope and recover from them
7. Explain the priorities for action on L&D at local and national levels, sharing solutions and providing recommendations.

Understanding the current landscape of risks in diverse contexts

The local-level information, insights and lessons provided by the case studies will support L&D practitioners, policy advocates, climate negotiators and other interested parties to:

1. Comprehend the many types of L&D risks

The case studies demonstrate the forms L&D impacts are likely to take in different geographies, who will be affected, and how. This will support designing responses that address the specific vulnerabilities of the countries, regions, communities and households that are most at risk. Readers will understand the impacts of L&D to be:

- Caused by a wide range of hazards, from rapid-onset events (for example, flood, cyclone and other extreme weather) to slow-onset (such as sea level rise, salination, desertification and glacier loss
- Highly varied, encompassing quantifiable economic impacts (such as damage to infrastructure, loss of land value, reduced productivity) and impacts that cannot be expressed in monetary terms (including loss of biodiversity, cultural heritage or identity)
- Not always reversible: many losses will be permanent
- Experienced differently by different people (for example, women, children, disabled people, Indigenous People, and other marginalised groups), regions (small islands, land-locked areas, coastal regions) and countries (with different fiscal capacities, political structures, infrastructure, institutions).

2. Examine how countries are currently managing risks

The case studies illustrate what has worked — or not worked — and under what circumstances. Readers will be advised which actions focused on:

- Mitigating the risks before events occurred (such as early warning systems, forecast-based finance and risk-informed early action)
- Adaptation measures to reduce the impacts during a climate event (such as moving livestock to higher ground during floods, taking communities to shelters during cyclones)
- Addressing reversible (such as rapid humanitarian response after events to support recovery and rehabilitation) and irreversible impacts (such as planned relocation and rehabilitation in places exposed to sea level rise)
- Transformative measures, which might have taken the form of pre-defined dynamic approaches for crisis response, enabling timely action when the need arose.

3. Explore L&D risk response

The diversity of the case studies will offer readers evidence that:

- Some countries are vulnerable even to lower-intensity climate stress, due to their infrastructure, socioeconomic development, fiscal capacity and so on

- Some people or social groups may be at a higher risk of adverse consequences from climate impacts: pre-existing factors such as poverty, social marginalisation, access to essential services and so on can both exacerbate experiences of L&D and limit capacity to cope with climate impacts
- L&D risk responses need to be framed across a wide range of national and local contexts

The case studies will also indicate which approaches and practices are likely to be most effective to address different forms of L&D. This evidence-based knowledge can be used to inform international and national policies and practices on L&D.

Informing policy discourse and identifying response mechanisms

The evidence presented here — on a diverse range of L&D challenges, responses and requirements for support — should equip the reader to inform and influence regional, national or international forums on:

1. **The realities of climate change L&D, and what should be considered in responding to it.** To help policymakers and other stakeholders adopt appropriate approaches when anticipating and planning responses to tackle L&D, it is important that they understand the potential risks that apply in different contexts, what factors define or influence the scale of impacts, and how and at what level it can be addressed.
2. **Which types of solutions are working in which contexts.** In the absence of external support, many governments in climate-vulnerable countries are developing their own mechanisms for L&D. And many communities are already trying out local and traditional coping mechanisms for survival. Harnessing a shared understanding of how effective these approaches and mechanisms are in addressing the different types of L&D risks could provide widely applicable guidance on which mechanisms can be scaled up in different circumstances.
3. **The existing gaps, and where support is needed.** It is important that the kind of support and finance needed to adequately address the dynamic and differentiated risks of L&D over time is understood by decision makers. The assumption should be that resource and capacity needs will differ depending on the context that drives underlying vulnerabilities.

Future work

We intend to continue facilitating actors from the global South to share knowledge and generate evidence on tackling L&D. We encourage you to provide feedback and suggest how we can (i) ensure better outreach to key stakeholders in this space; (ii) make the approach more collaborative and (ii) ensure that the process includes the voices of the most vulnerable and marginalised people.

The cost of flooding: how rising water levels hit household living expenses in Mwaja village, Singida, Tanzania

Author: Charles Isaya Mnyororo, WASH Technical Officer
Sustainable Environment Management Action (SEMA)



Geography	Africa; coastal; lakes
Location	Singida Municipal, Tanzania
Climate hazards	**Slow-onset:** unpredictable weather patterns, rising temperatures, droughts, decreasing rainfall **Rapid-onset:** flooding
Vulnerable groups	Women, children, farmers
Response mechanism	**Survival:** demarcation of flood-prone area **Recovery:** new infrastructure built in safe area

Context

Mwaja village is located in Singida Municipal in Tanzania. The village is surrounded by two lakes, Singida Munangi and Kindai, which are separated by a tarmac road. Some of the community members in Mwaja village depend on agriculture, while others are entrepreneurs and some are employed in government and the private sector.

Singida falls under the semi-arid region and is characterised by weather variabilities, resulting in droughts and floods. Climate variation-induced food shortages and famine occur frequently,[1] with their frequency increasing drastically since the mid-1990s.[2] Frequent droughts and floods cause major economic losses, reducing long-term growth and disrupting the communities' livelihoods. Climate change is affecting agricultural production[3] and a variety of other sectors, including water resources, public health, energy supply and demand, infrastructure, biodiversity and ecosystem services.

Since the turn of the century, Tanzania's average annual rainfall has been highly variable.[4] It is also decreasing by 3.3% per decade, while mean annual temperatures have increased by 0.23°C per decade from 1960 to 2003.[5] The National Adaptation Programme of Action (NAPA) for Tanzania projected a rise of 3 to 5°C daily mean temperature throughout the country,[6] and a decrease in annual rainfall of between 5 and 45%.

Mwaja village did not exist in the 1990s. The area was forested, and the people from Singida town used the area for cultivation. It was rich in natural fertiliser and the community was cultivating different crops, especially sunflower, without using any chemical fertiliser. However, from 2000 onwards, the use of chemical fertiliser has gradually increased in the area.

In the 1990s, the area received most of its rainfall between the end of October and the end of April. There was enough water available for agriculture. Today, the village experiences low rainfall and short rainy seasons, which are increasingly erratic due to climate change. Droughts are frequent, happening once every four years. The area's total rainfall ranges from 500mm to 800mm per annum, with high geographical, seasonal and annual variation.

The elders of Mwaja village said that more than 40 years ago, the two lakes were merged. But over time they started to dry out, leaving a dry patch in the centre. Due to decreasing rainfall, there was little hope that the two lakes would merge again. Hence, the authorities started building infrastructure such as a tarmac road and electric transmission line on the land separating the two lakes. The community used the road for commuting to town as it was shorter than the other routes.

However, in 2019–2020, the average rainfall doubled from 500mm to 1,000mm. This raised the water level of the two lakes and submerged the land. The rise in water levels immersed electric poles, tarmac road, houses and agricultural land located near the lakes. The road was also closed for more than four months between December 2020 and April 2021. The electricity authorities were forced to cut the electricity

1 Agrawala et al., 2003: Development and climate change in Tanzania: focus on Mount Kilimanjaro. IPCC, 2007: Intergovernmental Panel on Climate Change.

2 United Republic of Tanzania (2011). Poverty and Human Development Report. Research on Poverty Alleviation. Dar es Salaam

3 Kamau, J, Labeyrie, V, Njoroge, G, Wanjoya, A, Wambugu, P, Muthamia, Z, and Leclerc, C (2017) Dealing with farmers' Ethnolinguistic differences when collecting crop diversity on-farm. Plant Genetic Resources 15(5) 400-408. doi:10.1017/S147926211600006X

4 Quinn, CH and Ockwell, D (2010) The Link between Ecological and Social Paradigms and the Sustainability of Environmental Management: A Case Study of Semi-Arid Tanzania. In: Lovett, JC and Ockwell, D (eds) *A Handbook of Environmental Management.* Edward Elgar Publishing Ltd, Cambridge, 282–308.

5 Kabote, SJ, Mamiro, D, Synnevag, G, Urassa, JK, Mattee, AZ, Mbwambo, JS, Nombo, CI, Masolwa, LW and Chingonikaya, EE (2013) Inter-Annual Anomaly and Seasonal Variability of Rainfall and Temperature in Selected Semi-Arid Areas of Tanzania. *Journal of Continuing Education and Extension*, 4, 295–317.

6 United Republic of Tanzania (2007) The Urban Planning Act No. 8 of 2007. Dar es Salaam.

services. They decided to shift the line to safe land that was not prone to flooding. More than 70 households did not have access to electricity for more than a year, stopping some of the social and economic services in the area from functioning. This in turn led to the displacement of the 70 households from the area.

Impacts

1. Increase in transport costs

The lake flooding and road closure (see Figure 1) caused an increase in transportation expenses for the community living in Mwaja village for more than six months, though currently the water level has started to decrease. Women owning small businesses and students enrolled in schools located in the town were forced to pay double for transportation. The Bajaj fare transport doubled from Tshs 500 to TShs 1,000 per person after the tarmac road was flooded. These high transportation costs led to disruption in services and economic activities in the region.



Figure 1: before the water level increased, this power line was on dry land
Credit: Charles Isaya Mnyororo

2. Loss of community investment

Some businesses, such as the cement block fabrication and mill industries that were established in the area, were affected by the rising water level and stopped functioning. This caused a disruption in the services being provided by these industries. The community had to travel long distances to find alternative services.

3. Loss of fertility

The heavy rainfall caused soil nutrients to leach out, leaving the land with insufficient fertilisers. Farmers are therefore using chemical fertilisers and manures to improve soil nutrition and crop production.

Compounding risks/impacts created

In Tanzania, the agricultural sector contributes 29.1% of the gross domestic product (GDP), 65.5% of employment, 65% of raw materials to the industrial sector and 30% of export earnings.[7] The government of Tanzania has identified agriculture as a fundamental vehicle for realising the socioeconomic development objectives in the Tanzania Development Vision 2025 and the Five-Year Development Plan. Hence, agriculture is important for the country. The same is true for Mwaja.

As land was submerged by flooding in Mwaja, less land was available for agriculture and subsequently production decreased. This impacted the economy of the villages as 80% of the community in Singida depends on agriculture activities for their livelihood. In an agriculture-dominated economy, less agricultural production leads to an increase in poverty. Food expenses of farming households increase as they now have to buy food, cutting down on disposable incomes and savings.

7 The United Republic of Tanzania (2017) Agriculture Sector Development Programme Phase II (ASDP II). Ministry of Agriculture, Dodoma. https://www.datocms-assets.com/7245/1573630736-agricultural-sector-development-programme-ii-final-version-asdp-ii-november-2017.pdf

The flooding displaced 70 households, some of whom went to stay with their relatives, increasing the burden on the host households. The displacement to new areas was more stressful for students as they now had to spend more time commuting to school. The students were fatigued by the long hours and this affected their ability to concentrate on their studies.

Those losing money in businesses, such as the owners of the cement block factory and flour mill, underwent a stress period after the businesses closed. They had to look for alternative income generation to fulfil the basic needs of their family.

The impact created by climate change-induced flooding led to a reduction in open spaces in houses, and other areas that were used by people for social, environmental, and economic purposes.

Vulnerabilities/impacts by compounding risks

Due to an increase in the hours spent commuting, women who run businesses in town now keep shorter business hours, leading to lower incomes. Also, due to the increase in transportation costs, their net profits have suffered, leading to an increase in their vulnerability.

The flooding of fertile land means there is less land available in the village for agriculture. This has resulted in an increase in the poverty and vulnerability of households. Some households fail to access basic needs due to lower incomes at the household level. Some parents are unable to continue sending their children to school.

The flooding caused an increase in the health budget of the community. The pit latrines in the area started overflowing, polluting the water. This led to an eruption of diseases and increased spending on health. This additional burden, coupled with a reduction in incomes and insecurity in livelihoods, resulted in increased household vulnerability.

Adaptation measures

The government authority has demarcated the flood-prone area by installing a beacon that indicates the maximum water overflow, and the community is not allowed to make any settlement within the marked area. Also, government services like the electric power line that was within the flood-prone area are being shifted to areas safe from flooding.

The road agency created an alternative road for transportation. However, because it is a traditional road compacted with gravel, it takes longer for villagers to reach the town using this road.

The community members whose land and houses were affected by the flooding were shifted to other safe places.

Loss and damage beyond adaptation

Some of the community members lost their lands due to flooding, as well as through the demarcation exercise conducted by the government authority, which restricts settlement in flood-prone areas. These households incurred additional expenses either through building a new house or living in rented houses, all while suffering from reduced incomes and insecure livelihoods.

The government has constructed an alternative gravel road to reach town, though it takes longer than the previous tarmac road. The doubling of transportation costs is hurting households that already have reduced incomes and enhanced vulnerabilities.

The electric authority also now charges double the cost for shifting the existing electric power line, adding to people's burden and deterring their access to electricity.

Support needed in future

The community needs extension services to provide them with reliable information on climate change at the right time. These services can be provided through public campaigns, radio talk shows, giggles (comedy shows) and through other similar channels. Knowledge on climate change and its impacts will enable communities to be better prepared. Greater understanding of the history of the surrounding area and how it was 50 years ago will help communities to take precautions while planning settlements and exercising livelihood options in the future. This includes the rainfall pattern, maximum lake water levels, pathways of running water and so on.

While no country will be left unaffected by climate change, what differs is the financial capacity to handle the shocks. The government authorities in developing countries also need to be supported financially and technically to realise the risks, and to plan measures to reduce or prevent loss and damage to the community and government properties.

Lessons learned

The climate change strategies being used to tackle the impact are still at a basic level. For example, the government installed a beacon after the flooding, meaning they are waiting to take action only after the hazard occurs. This could be due to insufficient reliable data that addresses climate change and its anticipated impact.

There is a knowledge gap starting from the top level right down to the grassroots. There is a need for government leaders to build a greater understanding of climate change issues, and the financial and risk response instruments that will enable them to incorporate these issues into planning and budgeting.

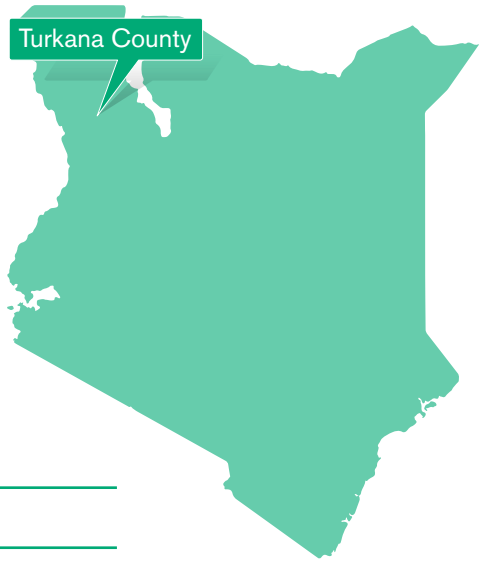
The community, without an understanding of climate change issues, settled on a flood-prone area, resulting in loss and damage of their properties. Therefore, there is a need to increase extension services that will inform the communities on climate change and its impact in the flood-prone areas.

Synopsis

This case study focuses on the impact of climate change due to flooding by two lakes in Mwaja village, Singida Municipal, Tanzania. The submergence of the tarmac road and electricity transmission line, and settlement displacement has led to an increase in the community's living expenses. Most of the community depend on agriculture and the submergence of farmlands has left them poorer and more vulnerable.

Seeking resilient livelihoods: a pathway to address climate-related loss and damage in Turkana County, Kenya

Authors: Edwin Odhiambo Siala, Alma García and Mattias Söderberg
DanChurchAid (DCA)



Geography	Africa; land-locked; Lake Turkana
Location	Turkana County, Kenya
Climate hazards	**Slow-onset:** increase in drought frequency, water stress, increase in evapotranspiration because of higher temperature **Rapid-onset:** flash flooding
Vulnerable groups	Women, children, older people, young people, disabled people, pastoralist communities
Response mechanism	**Anticipatory:** moving livestock to access pasture and water, keeping mixed livestock herds **Survival:** adopting sustainable livelihood alternatives, business skills training **Recovery:** essential training, climate-friendly policies, investment

Context

Turkana County accounts for 13.5% of the total land area in Kenya.[1] It is located in the northwest of Kenya and borders Uganda to the west, South Sudan to the north, and Ethiopia to the northeast. It is home to 926,976 people, of which more than half are below the age of 19.[2] This youth-dominated population profile indicates the need for urgent investments in education, nutrition, water and health. Due to its location, Turkana County has been receiving refugees from neighbouring countries to the Kakuma refugee camp, established in the early 1990s, and Kalobeyei settlement, established in 2016. Population growth, the expansion of the youth population and the adverse impact of recurrent droughts upon pastoralist communities have resulted in rapid levels of urbanisation in Turkana.

Kenya has experienced an increase in drought frequency from once in every ten years in the 1960s and 1970s to once in every two to three years in the 1990s. Since 2000, drought has become increasingly unpredictable. Turkana County is among the most vulnerable arid and semi-arid land (ASAL) regions in Kenya. Here higher temperatures and an increase in evapotranspiration are expected to cause more frequent climatic extremes, increased aridity, increased water stress, diminished yields from rainfed agriculture, and increased food insecurity and malnutrition.[3]

Impacts

Turkana County's economy is dependent on its natural resources and is highly vulnerable to climate variability. Rising temperatures and changing rainfall patterns result in increased frequency and intensity of extreme weather, events such as droughts and flooding. These extreme events threaten the sustainability of the county's development. Despite exposure and sensitivity to frequent droughts, pastoral economy accounts for 90% of the employment opportunities and 95% of family income and livelihood security in Kenya's ASALs.[4] In Turkana County, increasingly frequent extreme drought events have a negative impact on pastoral livelihood.[5]

More than 80% of the droughts that occurred in Turkana County between 1950 and 2012 covered a large area and had widespread impacts on other parts of Kenya.[6] These extreme conditions pose a major challenge to livelihood activities. For example, hot and dry conditions reduce forage availability and increase incidences of disease, enhancing livestock morbidity and mortality. Poor forage availability also leads to lower milk production, and consequently to malnutrition and poor health among children, since milk is one of the Turkana people's staple foods. During droughts, the people rely on wild fruits for foraging.

Seasonal mobility forms a critical element of pastoral communities' livelihoods in Kenya's ASALs. But with climate change, rural communities are facing increasing competition and conflicts over limited water and pasture resources. Increased incidences of human-wildlife conflicts threaten their lifestyles and trigger internal migration.[7] In addition to pastoral migration, the refugee population represents some 15% of Turkana County's total population. Nearly 80% of the refugee population is made up of women and children (approximately 148,000 people).

1 Government of Turkana County (2015) Turkana County Investment Plan 2016–2020.

2 Kenya National Bureau of Statistics (2019) 2019 Kenya Population and Housing Census Results.

3 Opiyo, F, Wasonga, O, Nyangito, M, Schilling, J and Munang, R (2015) Drought Adaptation and Coping Strategies Among the Turkana Pastoralists of Northern Kenya. International Journal of Disaster Risk Science (6) 295–309.

4 Ibid.

5 Government of Turkana County (2020) Turkana County Climate Change Policy.

6 Opiyo, F, Wasonga, O, Nyangito, M, Schilling, J and Munang, R, op cit.

7 CARIAA (2019) Contextualizing Pathways to Resilience in Kenya's ASALs under the Big Four Agenda.

Given the negative impacts of increased drought frequency on livelihoods, communities are increasingly getting involved in environmentally unfriendly alternatives. These include charcoal burning and unsustainable land management practices, such as over-grazing, and illegal and excessive fuelwood collection. All these activities further exacerbate the environmental degradation of already fragile dryland ecosystems. This has been compounded by poor resource governance — often due to institutional or tenurial barriers, poorly conceived policy enforcement and ineffective climate governance practices — that do not include the wishes and aspirations of the Turkana community.

Although the region is generally hot and dry, when the rains do come, the dry riverbeds fill quickly, causing dangerous flash flooding — a key climate stressor. This is the main factor causing loss of lives and livestock and devastating damage to people's property and infrastructure, such as roads and communication networks. Due to the quick onset of flash flooding and the relative rareness of such events, the population and authorities are not well equipped to deal with their impacts.[8]

Compounding risks/impacts created

The poverty rate in Turkana County is 72% versus a national poverty rate of 37%, while unemployment in the county is reported at more than 35%. The primary school enrolment rate is 48% and secondary school transition rate is 9%. Only 11% of Turkana residents live in improved housing with only 12% having access to the electricity grid. Most of this privileged population lives in larger towns like Lodwar, Kakuma and Lokichogio.[9] Access to improved water and sanitation services also remains low. Nearly 43% of people in Turkana take more than one hour to collect water in the dry season and 24% take more than two hours. Pastoralists are also among the groups most marginalised from socioeconomic services and infrastructure.[10]

Traditionally, Turkana pastoralists have used risk-diversifying strategies. These include moving livestock to access the best quality pasture and water available, and keeping mixed livestock species herds to protect against total loss of livestock in case of drought.[11] Over time they have learnt to cope with permanent water scarcity, variable inter- and intra-seasonal rainfall, and the recurrent risks of weather-related shocks. However, because of high poverty rates, changing socioeconomic and political circumstances, and demographic growth — coupled with the increased frequency of extreme events — traditional coping strategies are increasingly becoming insufficient.[12] This has led to the migration of rural communities to urban areas and regions around refugee camps, to access basic services like water, sanitation, education and health, as well as job opportunities.

Vulnerabilities/impacts by compounding risks

Decreasing animal herds, due to mortality caused by frequent droughts, have led to what community members refer to as a 'state of despair'. This has led to an increase in demand of a local alcoholic grain-based brew called chang'aa. Susceptibility to addiction, anxiety, and emotional distress among pastoralist Turkana communities is also on the increase.[13] Community members, especially young men and women, are increasingly abusing alcohol as a way of coping with stress and depression. This could be linked to the non-economic loss, caused by their transition from pastoralists to a settled community. There are no structured health and social systems in the community to deal with alcohol abuse. People

8 Government of Turkana County (2020) Turkana County Climate Change Policy.

9 UNHCR (2020) Socio-economic Profiling Survey of Refugees in Kalobeyei 2018.

10 Government of Kenya (2012) National Policy for the Sustainable Development of Northern Kenya and other Arid Lands.

11 Opiyo, F, Wasonga, O, Nyangito, M, Schilling, J, and Munang, R, op cit.

12 CARIAA (2019) Contextualizing Pathways to Resilience in Kenya's ASALs under the Big Four Agenda.

13 Mukulu Waila, J, Wandanje Mahero, M, Namusisi, S, Hoffman, SJ and Robertson, C (2018) Outcomes of Climate Change in a Marginalized Population: An Ethnography on the Turkana Pastoralists in Kenya. *American Journal of Public Health* 108 (S70–S71).

who abuse alcohol have reduced capacity to engage in livelihoods and economic activity, thereby further exposing them to a life of poverty and hopelessness. Migration to urban areas has also led to an increase of other social vices such as prostitution.

For women, alcohol abuse leads to abandonment of caregiver roles and increased exposure to sexual and gender-based violence when they go to urban areas to sell charcoal and firewood. Cultural beliefs and customs that people relied on, and that provided a sense of protection from physical and social harm, are being eroded. People find themselves isolated and alone in urban centres where they have no relatives. The social structures that provided protection seldom exist for people who have migrated. Furthermore, access to education for children is very poor, with malnutrition, displacement and migration preventing children from attending school.

Adaptation measures

Measures being employed by households and communities to deal with climate impacts and to try to minimise loss and damage risks include adopting alternative livelihoods systems such as growing vegetables or being involved in entrepreneurship. Communities prefer keeping certain livestock. Goats and camels are preferred to cattle as they can withstand harsher climate and do not have to feed on pasture. The more cows a pastoralist has, the more they are prone to frequent migrations and therefore communal conflicts, because of competition for limited pasture and water resources. For those who have cattle, another way of coping with climate impacts is to migrate to neighbouring countries, including South Sudan and Uganda. Some communities still practise age-old traditions like engaging the services of traditional seers, who often conduct rituals to appease their God to bring rains. This is an age-old tradition still being practised during prolonged drought seasons, albeit in limited cases.



Figure 1: sustainable market-driven interventions use input vouchers for provision of essential agricultural inputs and provide training on proper crop husbandry

Credit: Justin Ruharuka, DCA, Kenya

The NGO DanChurchAid (DCA), together with a local partner, has supported the adoption of sustainable alternative livelihoods like fisheries and poultry production among local communities (DCA has worked together with the local partner, SAPCONE, on fish value chain promotion). These are pursued through sustainable market-driven interventions, such as the provision of essential agricultural inputs through input vouchers, training on crop husbandry and poultry production, and capacity building on business (see Figure 1). Additionally, communities and women fish traders have been equipped with essential skills to manage their businesses, and support was provided for the formation of community-led savings and loan platforms to strengthen economic resilience (see Figure 2).



Figure 2: capacity building on business and entrepreneurship promotes livelihood diversification

Credit: Justin Ruharuka, DCA, Kenya

Recent studies show that DCA interventions have helped communities to adapt to climate change and strengthen their livelihoods. According to the results of a recent evaluation of their projects in Turkana, 54% of beneficiaries of DCA

interventions have an acceptable food consumption score, while 14% have a borderline food consumption score. This indicates that the proportion of people participating in DCA interventions that can access and consume a variety of foods is higher than average. Additionally, 79% of communities supported by DCA had a high dietary diversity score. And 81% of youth trained in business skills by DCA acknowledge that they have significantly improved, with 50% saying they started businesses after receiving the training.

Loss and damage beyond adaptation

Climate change has caused some non-economic losses that could not be avoided through existing coping and adaptation measures. These include the loss of community value systems and traditional protective structures that individuals would turn to in case of vulnerability. In other words, displacement to urban areas has led to the disruption of the social fabric and the loss of community connections. Furthermore, migration to neighbouring territories in search of water and pasture resources triggers inter-tribal and cross-border conflicts over such limited resources. This has in certain cases led to loss of lives among the Turkana or the neighbouring Pokot communities. The influx of light arms is a compounding problem, which has led to the deterioration of security in the area.

Economic loss and damage due to climate change, specifically related to Turkana County is not documented.

Support needed in future

To help communities cope with these existing and anticipated climate losses and damages, both economic and non-economic support are needed:

- Provide essential training to communities on climate-smart agriculture, agroecology, livelihoods diversification, water resource management and economic empowerment. This will inform them of various aspects of climate change adaptation and disaster risk mitigation.
- Promote access to climate-smart agriculture technology such as shed nets, irrigation equipment, solar-powered energy sources, livestock breeding and appropriate water harvesting to provide communities with alternative livelihoods sources.
- Develop climate-friendly policies at county government level and establish structures to operate carbon compensation mechanisms at national level. These should promote local community participation in climate mitigation projects. For example, carbon compensation mechanisms could finance afforestation programmes to increase forest cover affected by climate change-induced desertification. This would address the loss of forest cover and prevent the indiscriminate logging of trees for charcoal.
- Develop policies to enable investment of more resources to counties affected most by climate change. For example, setting up multi-level climate governance instruments such as partnerships, platforms, funding mechanisms and action plans to support public participation on climate issues, and ensure availability of sufficient finance for local climate action.
- Develop multi-stakeholder initiatives (government, NGOs and so on) to provide psychosocial support to help with non-economic losses related to culture and tradition, as well as resettlement.

Lessons learned

The lessons identified from experience that can help develop climate change adaptation strategies include:

- Prioritise local action in climate governance and mitigation interventions by including local people and communities. Give priority to climate solutions generated in local communities that address their interests.

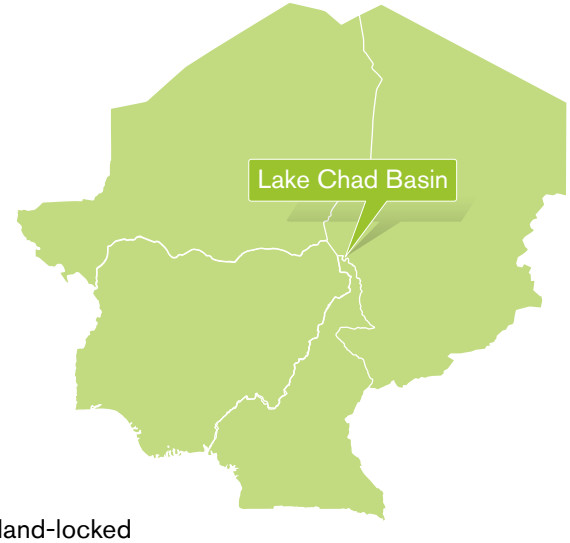
- Invest in climate change initiatives at local and national level. Climate change initiatives should be implemented at multiple levels of the economy. National climate change actions can give the necessary impetus for local resource allocations and policy support.
- Support small projects that address different aspects of loss and damage among affected communities. These projects should deal with livelihoods diversification, climate-smart agriculture, agroecology, nutrition, and household economic development through business and entrepreneurship skills development.
- Promote a nexus approach — merge humanitarian, development, and climate action and support in a way that ensures connected planning and response, and builds on community resilience. This would help humanitarian actors to make intentional links between the failure to address climate change loss and damage, and overall inability to realise development goals.

Synopsis

Turkana County in Kenya is experiencing more frequent climatic extremes, such as droughts and flash floods, which threaten the sustainability of the area's development as they impact negatively on pastoral livelihoods. These effects of climate change — in combination with other local vulnerabilities like poverty and lack of access to basic services — have increased competition and conflicts over limited resources. They have pushed rural communities to migrate to urban areas, where social vices such as alcoholism and prostitution have risen as ways of coping with stress and depression. Future effects of climate change will lead to additional economic and non-economic loss and damage in the area. Therefore, it is necessary to provide support to help communities to build resilience to minimise and address climate losses and damages.

Shrinking options: climate change, displacement and security in the Lake Chad Basin

Author: Amali Tower, Founder and Executive Director
Climate Refugees



Geography	Least developed countries; Africa; land-locked
Location	Lake Chad Basin (Nigeria and Niger)
Climate hazards	**Slow-onset:** unpredictable weather patterns, droughts, longer dry spells, extreme heat **Rapid-onset:** flooding and off-season shorter and more intensive rains
Vulnerable groups	Women, children, older people, disabled people
Response mechanism	**Anticipatory:** disaster risk reduction (early warning system at communal level, based on risk mapping climate conditions) **Coping:** adaptive agricultural practices, social cohesion training, promoting a market-driven agricultural system

Context

Lake Chad is located in Africa's Sahel, and is characterised as a closed basin within an arid to semi-arid region. Temperatures here have risen nearly 2˚C since the 1960s. Lake Chad spans Cameroon, Chad, Niger and Nigeria. At least 40 million people live in this region, most of whom are dependent on the lake for livelihoods like fishing, farming and subsistence living.

Climate change effects such as reduced and erratic rainfall, coupled with high temperatures, are leading to high rates of lake water evaporation. This causes drought-like conditions and the lake to recede — at times — by as much as 90% over the past 50 years.[1] At the same time, population increase and dams and reservoirs built on the tributaries that feed the lake have also contributed to the lake's decline. This is impacting livelihoods in fishing, agriculture and livestock, that were once sustained by the lake.[2] 60% of the population use the lake's water for agriculture purposes.[3] Importantly, the lake is not always in decline. Rainfall variability creates excessive rains that replenish the lake and cause flooding. However, it is the increasing variability of the lake's size, along with the frequency of extreme and intense weather events, caused by climate change, that render livelihoods insecure, increase natural resource conflicts and decrease the capacity to withstand climate shocks.

Countries studied for this research include Cameroon, Chad, Niger and Nigeria, with fieldwork in the Niamey and Diffa regions of Niger, and in Abuja and Maiduguri in Nigeria. Sub-national regions and villages were covered through fieldwork, and interviews of displaced persons were conducted from Niger (Arij, Zinder state and Komodougou river environs) and Nigeria (villages in Marte, Mafa, Dikwa, Kondugu, Masa, Damasak, N'Gala, Magumari, Benwe State, Adamawa State, Kukawa, Malamafatari, Kablewa).

Impacts

Climate shocks, conflict and competition for resources combine to hinder livelihoods and food security in the Lake Chad Basin (LCB), where agriculture is the main sector[4] of the economy. Sahel temperatures increase 1.5 times faster than the global average,[5] scorching the earth to dry and dusty conditions where seeds planted cannot take proper root. The Lake Chad Research Institute (LCRI) in Maiduguri, Nigeria has been studying the effects of climate change on the lake since 1976. It told research organisation Climate Refugees that a temperature increase of 1˚C above 20˚C, results in a 2% loss of crop yield. Several locations in the LCB have seen temperatures increase from 24 to 26˚C.[6] In Kanu, Nigeria, temperatures have stayed at 24˚C for the past ten years.

Rainfall variability,[7] predicted to decrease 11–13% in the next two decades, has led to conditions where seasonal crop planting and harvesting has become unpredictable.[8] Crops are unable to take root and

1 The European Space Agency (22 March 2019). Lake Chad's Shrinking Waters. https://www.esa.int/ESA_Multimedia/Images/2019/03/Lake_Chad_s_shrinking_waters

2 Ross, W (31 March, 2018) Lake Chad: Can the vanishing lake be saved? BBC News. https://www.bbc.com/news/world-africa-43500314

3 Mahmood, R, Jia, S and Zhu, W (2019) Analysis of climate variability, trends, and prediction in the most active parts of the Lake Chad basin, Africa. *Sci Rep* 9, 6317. https://doi.org/10.1038/s41598-019-42811-9

4 Ibid.

5 Climate Centre (14 November 2018) UN: Sahel Region One of the Most Vulnerable to Climate Change. https://www.climatecentre.org/981/un-sahel-region-one-of-the-most-vulnerable-to-climate-change/

6 Tower, A (2017) Shrinking Options: The Nexus Between Climate Change, Displacement and Security in the Lake Chad Basin. Climate Refugees. (Stakeholder interview with Dr. Zakari Goji Silas Turaki, Director of Research, Lake Chad Research Institute (LCRI)) https://adobeindd.com/view/publications/bf1670bb-4562-402e-a6c2-ebb3298cf8e5/1/publication-web-resources/pdf/Shrinking_Options_The_Nexus_Between_Climate_Change,_Displacement_and_Security_in_the_Lake_Chad_Basin.pdf

7 Ibid.

8 Mahmood, R., Jia, S. & Zhu, W. Analysis of climate variability, trends, and prediction in the most active parts of the Lake Chad basin, Africa. *Sci Rep* 9, 6317 (2019). https://doi.org/10.1038/s41598-019-42811-9

flourish when the expected rains do not come. Then, off-season rains — increasingly intense with monsoon-like conditions — cause fertile topsoil to wash away, taking with it essential soil nutrients. Seeds that have already been planted are also lost. This has been one contributing factor to successive years of failed harvests.[9]

With lake contraction, internal movement closer to the lake's shores has spurred competition over dwindling resources.[10] At the same time, ongoing conflict from 2009 between the insurgent group Boko Haram and Nigeria spilled over into the region, impacting agricultural production.

Climate Refugees also interviewed 105 refugees and internally displaced persons (IDPs) across Niger and Nigeria displaced from villages surrounding the lake. All participants reported experiencing the impacts of climate change for an extended period. These included unpredictable weather patterns, droughts, longer dry spells, extreme heat, flooding and off-season shorter and more intensive rains, all of which had lasting impacts on the lake — a life source for all residents. Some spoke extensively of floods destroying crops and people initially moving to highlands to take cover, before eventually fleeing the region to seek refuge in cities, long before the start of the Boko Haram violence.

Others said lower crop yields from overgrazed land, a lack of rain and adverse climatic conditions forced them to move internally within their region in search of more arable land. Still, others said they had adapted to the changed climate by anticipating the path and timing of the lake's shrinking. Multiple participants reported a swell in mosquitoes and illnesses among family and community members, which they self-attributed to climate change.[11] Interestingly, the Intergovernmental Panel on Climate Change (IPCC), in its Fourth Assessment Report, noted that climate change had altered some disease vectors like mosquitoes.[12] Local experts said the data and field evidence indicate that climatic changes are forcing people to migrate.

Compounding risks/impacts created

LCB residents have been on the move for decades, moving southwards in search of more fertile soil for farming, and with lake shrinkage, closer to its shores for water access.[13] Thus, while the start of the conflict in 2009 forced many out of the LCB, many were first displaced within the basin because of climate change.[14] Refugees and IDPs also noted this internal displacement in numerous interviews, some reporting their first displacement as early as 1973.[15] That displacement further destabilised populations already vulnerable from poverty, and brought them into closer contact with Boko Haram, eventually forcing their flight out of the region completely.[16]

Both LCRI and IDPs told us that as climate shocks deepened livelihood loss, many in this area totally abandoned farming and fishing, heading to urban centres for employment. LCRI also notes the difficulty of disentangling the connection between climate and conflict to determine the true extent to which climate

9 Tower, A (2017) Shrinking Options: The Nexus Between Climate Change, Displacement and Security in the Lake Chad Basin. Climate Refugees. (Stakeholder interview with Dr. Zakari Goji Silas Turaki, Director of Research, Lake Chad Research Institute (LCRI))

10 Adelphi (2019) 'Shoring Up Stability: Addressing Fragility Risks in the Lake Chad Basin.'. https://shoring-up-stability.org/wp-content/uploads/2019/06/Shoring-up-Stability.pdf

11 Tower, A (2017) Shrinking Options: The Nexus Between Climate Change, Displacement and Security in the Lake Chad Basin. Climate Refugees. (Refugee, IDP interviews, Diffa Region, Niger and Maiduguri, Nigeria)

12 IPCC, Fourth Assessment Report. https://www.ipcc.ch/assessment-report/ar4/

13 Tower, A (2017) Shrinking Options: The Nexus Between Climate Change, Displacement and Security in the Lake Chad Basin. Climate Refugees. (Stakeholder interview with Dr. Zakari Goji Silas Turaki, Director of Research, Lake Chad Research Institute (LCRI))

14 Ibid.

15 Tower, A (2017) Shrinking Options: The Nexus Between Climate Change, Displacement and Security in the Lake Chad Basin. Climate Refugees. (Refugee, IDP interviews, Diffa Region, Niger and Maiduguri, Nigeria)

16 Ibid.

change has contributed to decreased agricultural cultivation. This is because, while decades of data on climate changes have been collected, those related specifically to climate-related displacement have not been collected as meticulously. Consequently, LCRI points to a significant loss of human capital, perhaps even millennia of Indigenous farming and cultivation knowledge. This reminds us that even devoid of conflict, climate shocks have caused agricultural losses in this region.

Refugees and IDPs interviewed said multiple internal displacements per year had caused their children to forego school. This is a highly underdeveloped region, with generally only one school.[17] Climate change has therefore forced many displaced communities to choose between moving closer to the receding lake to access water, fish, trade and economic survival, and their own children's educational development.

Development indicators in the LCB are lower than the national averages of all four countries.[18] As a result, fishermen and subsistence farmers have often felt marginalised by their governments, manifesting in underdevelopment, and exacerbated by the impacts of climate change. It is no coincidence then that Boko Haram has established itself in the LCB, capitalising on the neglected region as a base from which to attack, recruit and expand control.

Both the effects of climate change and the onset of recurring attacks by both warring parties have resulted in more than five million people becoming displaced[19] throughout the region, both internally and across borders. According to the UN, 10.7 million people need humanitarian relief to survive.[20]

The displacement of communities has sustained Indigenous cultural loss. The Indigenous ways of life of nomadic herdsmen, their fisheries and trades, and traditional existence — all practised for thousands of years — have been lost or altered due to displacement and exile. LCRI told us the crops they research are inherited Indigenous 'land race' varieties, and before conflict rendered the region inaccessible, research was oral and hands-on with local farmers sharing their traditional ways of life.[21]

With increased populations in Nigerian cities like Maiduguri, which has 20 times[22] more inhabitants than in the 1960s, increased demand for housing and resources such as water and arable land are creating local conflicts between farmers and pastoralists. A World Bank study[23] of the LCB found influxes of displaced communities have strained host resources and capacities such as water supply, education and health services in already vulnerable communities. This has resulted in increased tensions between displaced and host communities.

Vulnerabilities/impacts by compounding risks

Even before the conflict, disruption to education caused by climate displacement heightened the risk of exploitation and the recruitment of child combatants (boys). Not to mention kidnap and gender-based

17 Ibid.

18 World Bank, Lake Chad Basin Commission (2015) The Lake Chad Development and Climate Resilience Action Plan. https://openknowledge.worldbank.org/bitstream/handle/10986/23793/Main0report.pdf?sequence=1&isAllowed=y

19 IOM Displacement Tracking Matrix (21 May 2021). Displacement Tracking Matrix: Lake Chat Basin. Monthly Dashboard 32. https://displacement.iom.int/reports/west-and-central-africa-%E2%80%94-lake-chad-basin-crisis-monthly-dashboard-32-21-may-2021

20 Ross, W, op cit.

21 Tower, A (2017) Shrinking Options: The Nexus Between Climate Change, Displacement and Security in the Lake Chad Basin. Climate Refugees. (Stakeholder interview with Dr. Zakari Goji Silas Turaki, Director of Research, Lake Chad Research Institute (LCRI))

22 Krinninger, T (7 December 2015) Lake Chad: Climate Change Fosters Terrorism *Deutsche Welle*. https://www.dw.com/en/lake-chad-climate-change-fosters-terrorism/a-18899499

23 World Bank, Lake Chad Basin Commission, op cit.

violence of girls, as seen in the abduction of school girls in Chibok, Nigeria.[24] In camp and urban contexts, education is lacking, undermining generations of children displaced by both climate and conflict.

Finding farmland that is safe and unclaimed by host communities is sometimes impossible, especially for women whose husbands have been killed, captured or recruited by the conflict. In non-displacement contexts, the impacts of livelihood loss are particularly acute for women and girls who have had to take up jobs outside the home for economic survival. Girls are forced to forego school to undertake lengthy travel in search of water and firewood, putting them increasingly at risk of gender-based violence during travel.

Displacement also disrupts family social cohesion, with numerous reports of domestic disturbances and gender-based violence in camps. Violence increases from frustration due to lack of food, improper food aid, and loss of identity, culture and known ways of life.[25] Disabled people and elderly communities with special needs are at high risk with provisions totally lacking or inadequate in displaced shelters, and in overcrowded cities like Maiduguri.[26] For men and boys, employment, livelihood and income-generating activities are almost non-existent. This leads to frustration, depression and other mental health challenges, as well as leaving them vulnerable to radicalised ideologies and recruitment by Boko Haram.[27]

Adaptation measures

Climate adaptation is the key to survival and growth in the LCB, but access to the area has been limited by conflict. Several climate-adaptive strategies have been developed by LCRI. These include heat-resistant seeds, technological developments and vocational training for farmers. However, decades of underdevelopment and poverty are consistent barriers for farmers who cannot afford the climate-resilient seeds and adaptation measures. Communities have been coping by making multiple moves to the lake's shores, described as 'chasing the water'. When that too is insufficient, both men and women adapt by taking on new trades.[28]

To adapt to increased temperatures, LCRI recommended farmers plant seeds by 15 November to ensure good crop yields. However, impoverished farmers sometimes delay planting, due to the high costs of seeds. LRCI notes that a one-week delay in planting results in a 30% loss in crop yield. It says climate adaptation efforts like heat-resistant seeds are stymied by extreme poverty and access issues caused by conflict-driven insecurity.

Working with local government, NGOs are piloting climate-adaptive demonstration farms to show planting, harvesting, weed management and innovative water conservation techniques. NGOs provide resilient seeds proven to be more adaptive to changed climates and are also linking communities to agricultural dealers who can sell farmers' excess harvests.[29] Farmers are encouraged to grow crops for daily use and future reserve, marking excess for sale and thereby promoting a market-driven agricultural system. Adaptive strategies include: promoting crop rotation systems, limiting the use of chemicals, mulching systems that prevent water run-off, innovative sources of water conservation, and the collection and promotion of organic composting to offset the lack of organic material in the soil from overgrazing. Some NGOs integrate social cohesion training into agricultural livelihoods programming to educate, build and promote peaceful co-existence between displaced and host communities. Disaster risk reduction is also being

24 Tower, A (2017) Shrinking Options: The Nexus Between Climate Change, Displacement and Security in the Lake Chad Basin. Climate Refugees. (Refugee, IDP interviews, Diffa Region, Niger and Maiduguri, Nigeria)

25 Ibid.

26 Ibid.

27 Ibid.

28 Ibid.

29 Ibid.

integrated into climate agricultural adaptation with an early warning system at the communal level based on risk mappings of heavy rains, crop disease and other climate conditions.[30]

Loss and damage beyond adaptation

Regardless of the possible cessation of conflict, populations have already sustained lifelong losses and damages. Millions of lives have been upended by both climate change and conflict. Lake Chad has receded to an extent where livelihood loss is almost permanent. Lake renewal is only possible if seasonal rains and optimal temperatures arrive when expected and are sustained over a long period. This has not happened in decades and we now know that global warming and climate change are unlikely to allow that to return.

At the same time, the significant underdevelopment of the population in this region renders them unable to adapt to new vocations. Cultural loss is significant and violates Indigenous, economic, social and cultural rights, while food insecurity is endemic.

Support needed in future

To help communities adapt to climate change, improve natural resource management and promote and provide access to new economic opportunities, various support is needed:

- To conduct climate fragility assessments of infrastructure, especially in growing urban and displaced centres like Maiduguri
- To conduct market assessments to tackle unemployment where lost livelihoods can be redirected. This is especially vital for displaced persons who want economic opportunities, training, and land tenure to self-sustain in their new living contexts
- For improved information, technological transfers and better climate information, especially for communities still surrounding the lake region
- For better preparation to respond to climate shocks, markets and scenarios that impact their lives
- Research support to develop best practices on climate adaptation measures that mitigate climate displacement
- To create links between humanitarian and development actors, who can work together to develop more flexible projects that assist communities most threatened by climate change
- To ensure climate adaptation is fully integrated into livelihood and early recovery programming
- Investment in strengthening peacebuilding initiatives by local civil society, such as social cohesion, community engagement and dialogue, as well as the creation of development-security links to prevent and counter violent extremism.

Lessons learned

While conflict poses significant restrictions to adaptation and access, the millions living in displacement can be helped. Stronger financing towards climate adaptation within the LCB — where access is not hindered by conflict — and adaptation and integration of displaced people within host communities, is essential for building resilience.

30 Ibid.

Complex drivers of conflict, poor governance, poverty and climate change, are driving displacement in this region. Underdevelopment has weakened climate change adaptive capacity. LCRI-developed climate adaptive strategies such as training, farming demonstrations, tools, alternative crops and heat-resistant seeds are cost prohibitive to most farmers, so tackling poverty alongside climate resiliency is key. IDPs said they could not afford the technologically advanced seeds and alternative crops, and so replanted the same seeds year after year. While agricultural fertilisers are subject to government restrictions because of their potential use in improvised explosive devices by Boko Haram on farmland areas.

At least five NGOs interviewed have introduced adaptation programmes to address the impacts of climate change among displaced communities.[31] These should be enhanced with further funding and support to increase resilience and rebuild livelihoods of displaced communities. With a large proportion of communities and displaced persons being agriculturally dependent, such programming should be scaled up to build resilience.

Adaptation efforts should also ensure that a rights-based approach is pursued that guarantees:

1. Equal access and non-discrimination in the selection of participants in climate adaptive programmes
2. Access to information and full participation of affected communities, especially marginalised groups, in planning, designing and decision making, and
3. That the economic, social and cultural rights of the affected communities should form the basis of the climate adaptive measures.

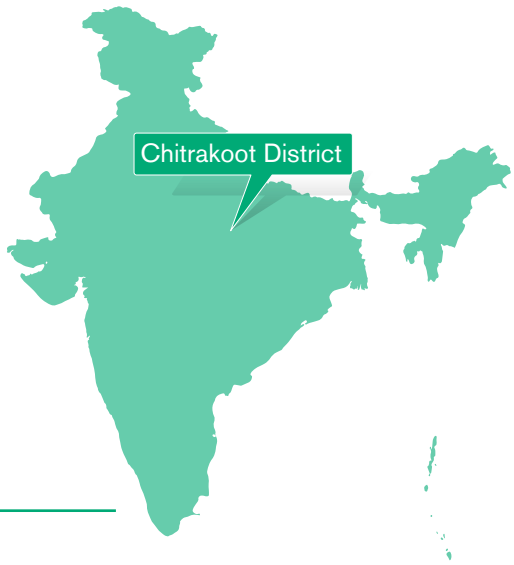
Synopsis

Climate shocks in the Lake Chad Basin have played a significant role in the displacement of over five million people in this region. While the regional conflict between these countries and the insurgent group Boko Haram that began in 2009 is the main driver of recent displacement, it is by no means the area's first instance of forced movement. Climate change and climate variability (manifesting in irregular rainfall, temperature rises and drought), along with poverty and underdevelopment, have caused livelihood loss here for over 45 years, deeply impacting subsistence farming, fishing and pastoral communities.

31 Ibid.

India's water crisis: the impact of extreme heat and drought on communities in Chitrakoot, India

Author: Neelmani Gupta, Coordinator-Documentation
Shramik Bharti



Geography	Asia; hilly
Location	Chitrakoot district, India
Climate hazards	**Slow-onset:** droughts, longer dry spells, extreme heat, rainfall variation **Rapid-onset:** flash flooding, forest fires
Vulnerable groups	Women, children, Kol communities, small-scale farmers
Response mechanism	**Anticipatory:** government programmes **Survival:** infrastructure (farm ponds), adaptive farming practices **Recovery:** rehousing programme

Context

The ancient Hindu pilgrimage city of Chitrakoot lies on the border of Madhya Pradesh and Uttar Pradesh states, India (see Figure 1). The landscape is hilly and undulating and there are many rivers and rivulets in the district.

Chitrakoot is one of the 115 most underdeveloped areas and highlighted as an aspirational district for getting priority development support by Niti Aayog,[1] an Indian government public policy think tank. 90% of the population in Chitrakoot lives in rural areas[2] and more than one third of the households fall in the Below Poverty Line (BPL) income category (see Figure 2).

The district's climate is dry, with a maximum temperature of 50.5°C in May and a minimum of 5°C in January. It receives about 92% of its annual rainfall between June and September (mean annual rainfall is 814.8mm, varying by 120). The number of rainy days ranges from 31–41 days per year and the district has between 269.5–296.2 dry days per year.[3]

Chitrakoot is prone to heat stress and recurrent droughts. Chitrakoot has experienced seven long and severe drought events during the last 38 years.[4] In 2011, despite above average rainfall and flash flooding in many districts in the region, Chitrakoot still suffered from a drought.

The forests in Chitrakoot are predominantly tropical, dry, mixed and deciduous. Forest destruction has had an impact on the perennial character of the rivers, the groundwater recharge pattern, soil productivity, people's lifestyles, social morals and ethics. The loss of forest cover gave rise to flash floods from streams and rivers, eroding the surface soils and creating ravines.

For most of the year, the district's residents face acute water shortages, both for irrigation and domestic use.

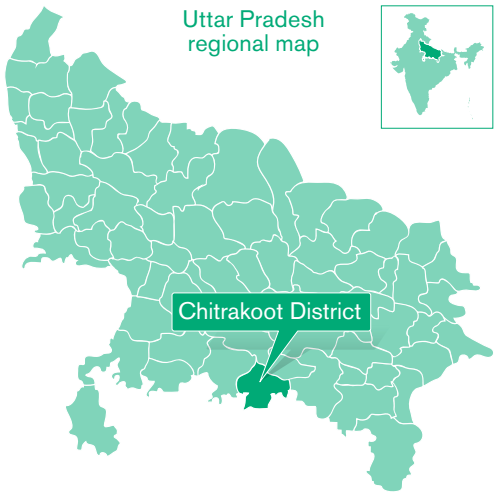


Figure 1: map of Uttar Pradesh

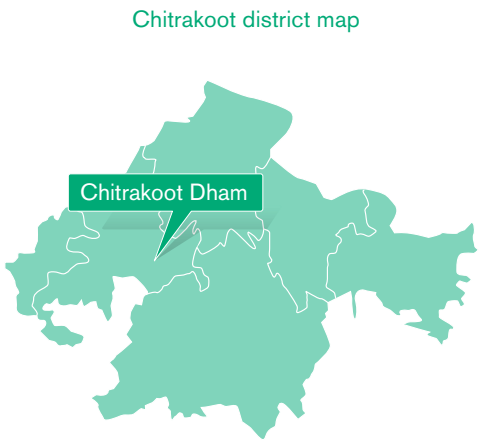


Figure 2: map of Chitrakoot District

1 Piramal Foundation (2020) https://cdn.s3waas.gov.in/s33b8a614226a953a8cd9526fca6fe9ba5/uploads/2020/08/2020080485.pdf

2 Census Organization of India (2011) Census 2011. Chitrakoot District: Population 2011-2021. https://www.census2011.co.in/census/district/542-chitrakoot.html

3 Tripathi, A (2014) Socioeconomic Backwardness Increases Vulnerability to Climate Change: Evidence from Uttar Pradesh. IEG Working Paper No. 337, Indian Institute of Economic Growth, Delhi. http://iegindia.org/upload/publication/Workpap/wp337.pdf; Pulak, G, Sudeep Kumar, BL, Menon, P, Prasad, AK, Sable, ST and Advani, SC (2020), Observed Rainfall Variability and Changes over Uttar Pradesh State, Climate Research and Services, India Meteorological Department, Ministry of Earth Sciences, Pune.

4 Pandey, V, Srivastava, PK, Singh, SK, Petropoulos, GP and Kumar Mall, R (2021) Drought Identification and Trend Analysis Using Long-Term CHIRPS Satellite Precipitation Product in Bundelkhand, India, Sustainability 2021, 13(3), 1042. https://doi.org/10.3390/su13031042

Impacts

The potential impact of climate change in Chitrakoot (extreme temperatures and annual rainfall variation) is high, while there is a low adaptive capacity.[5]

Frequent drought spells have intensified the dryness in the region and harmed natural water sources, biodiversity and soil carbon. Frequent droughts also lead to forest fires. In the summer of 2021, around 20km^2 of forests were destroyed by forest fires in Devangana Ghati, Chitrakoot.

Climate change has severely affected the lives and livelihood of the poor and marginalised living in the district. The poor are heavily dependent on climate-sensitive sectors like rainfed agriculture and forests.

The agriculture sector in the district suffers from the following climate-induced impacts:

- Irregular rainfall
- Shifts in monsoon rains causing delay in sowing, delay in harvesting and decreased crop yield. This results in reduced incomes for small and marginal farmers
- Phenological changes in fruits like guava, mango, persimmon, cudpahnut, wood apple and blackberry
- Shortage of livestock fodder, resulting in poor livestock health.

Heat stress affects animal production and reproduction, the number of livestock being maintained by households, disease occurrences, and product quality.[6] Villagers from the area shared that for the last five years, domestic animals (especially buffalo) have faced insemination difficulties. Animals have to undergo the process of insemination two to three times to get pregnant. This delay in impregnation causes livestock farmers to lose income.

Chitrakoot has also witnessed a severe drinking water crisis owing to multiple drought spells. Most of the tanks and ponds — as well as traditional and masonry wells used for drinking water — have dried up. About 151 ponds have disappeared since 2010.[7]

The hard, rocky and hilly terrain, high run-off rates, overexploitation of groundwater and inadequate groundwater recharge have resulted in water table depletion. The groundwater quality has also deteriorated — nitrate as a natural contaminant is above the recommended levels — making it unfit for drinking. Due to a scarcity of surface water, there is a high dependence on groundwater extraction. This has led to the deterioration of groundwater quality and impacted the health of people in the region.

The rich biodiversity of Chitrakoot is fast decreasing due to a reduction in water flow of perennial rivers and the depletion of groundwater. There are certain high-value medicinal plants that have been assessed as 'threatened' under IUCN Red List categories (2000) in the forests of the district.[8] The medicinal plants are used by the poor and marginalised Kol community, living in the forest fringe areas of the district.

Most of the Kol community members do not have a legal land title. Subsistence agriculture on leased land or encroached forest land is their main occupation, while collecting and selling fuelwood and minor forest produce is their main source of income. Members of the community also work as wage labourers in stone quarries in the region. The Kols use their traditional knowledge of medicinal plants for treating humans and livestock. However, due to climate change, the natural habitat is fast disappearing and many of the

5 Tripathi, A, op cit.

6 Escarcha, JF, Lassa, JA and Zander, KK (2018) Livestock Under Climate Change: A Systematic Review of Impacts and Adaptation, Climate 2018, 6(3), 54, p.8. https://www.mdpi.com/2225-1154/6/3/54

7 District Climate Resilience Plan of Chitrakoot, (2019) p.15. https://cansouthasia.net/dcrp-chitrakoot/

8 Sikarwar, RLS (22 May 2011) 'Earth's Living Treasure.' National Conference on Forest Biodiversity, Uttar Pradesh State Biodiversity Board.

medicinal plants are becoming extinct. Moreover, the young generation of Kols is migrating to urban centres and is not interested in learning about traditional medicines.

Distress migration in large numbers is a common feature in Chitrakoot. Frequent droughts have led to the loss of livelihood and people, especially from the poor and marginalised communities, as they migrate to other districts or states in search of better livelihood opportunities.

Compounding risks/impacts created

The potential impact of climate change on rural areas is high in Chitrakoot district, which is highly exposed to climate change and variability.[9] Frequent disasters such as drought, heatwaves and water stress result in the district performing poorly in all human development indicators. The district has a composite Human Development Index (HDI) of 0.399, lower than the national average of 0.632.[10]

The majority of farmers have small land holdings. Farming is largely carried out to ensure food security and surplus produce is sold to meet other household expenses. Droughts have resulted in crop losses and affected agriculture-based livelihoods such as livestock rearing. Loss of income and livelihood increases poverty and marginalisation among small farmers.

In the absence of sustainable livelihood options, people either depend on agriculture with diminishing returns or migrate to work as wage labourers. Kols, particularly, are forced to work in stone mines under exploitative conditions.

Women are sexually exploited by landowners and mining industry contractors, locally known as *Dadus*. In many cases, youth have migrated, leaving behind women, children and elderly people.

The food and nutritional security of children is also being compromised. As per the National Family Health Survey (NFHS) 2015–16, approximately 50% of children in the district are stunted (height-to-age), 33% wasted (weight-to-height), and 51% underweight. Malnutrition among adolescent girls and children results in poor health and reduced immunity. This then burdens poor households with higher healthcare costs.

The migration of men increases the responsibility and workload of women, making them the only caregivers for both children and the elderly. Most of these women also belong to poor families and are already in poor health. The NFHS 2015–16 said 36% of women in the district have a BMI (Body Mass Index) that is below normal (BMI < 18.5 kg/m^2).

The water crisis further aggravates the vulnerabilities of women with respect to sanitation and hygiene, especially menstrual hygiene, making them prone to diseases. Health-related expenses push these poor people in a vicious cycle of debt and unending exploitation.

Vulnerabilities/impacts by compounding risks

Groundwater depletion compounds the impact of climate change. The grim water situation in the region is best illustrated by a local saying, “let the husband die but the earthen pot of water should not be broken”.[11]

Under severe water stressed conditions, women have to cover long distances to collect water for livestock and domestic purposes, as well as being engaged in other economic activities like farming and livestock rearing. Fetching water involves getting up early, walking long distances and waiting for hours in a queue.

9 Tripathi, A, op cit.

10 UNDP (2012) Human Development Report: Bundelkhand. National Institute for Transforming India, pp.1–280. https://www.undp.org/content/dam/india/docs/human-development/District%20HDRs/Bundelkhand%20Report_23Jan2018.pdf

11 Rai, M (2007) Climate change and agriculture: *A Nepalese case. Journal of Agriculture and Environment* 8, 92-95.

Often children — mostly girls — help their mothers with this task. When they are not with their mothers, children stay at home to look after their younger siblings or perform household chores with a view to support their mothers. It deprives girls of an education, as well as stopping them from playing and enjoying their childhood.

Many poor households are forced to sell their assets to make ends meet. When all hope fails, suicide is a reality for many households. There have been many stories reported by local and national media of farmers taking their own lives after failing to repay their debts and due to starvation.[12]

Adaptation measures

Government agencies, NGOs and communities living in the area have taken various adaptation measures.

Government measures: at the national level, the Indian government launched a National Action Plan on Climate Change (NAPCC) on 30 June 2008. Similarly, all Indian states have developed State Action Plans on Climate Change in line with the NAPCC to define how they will integrate climate change adaptation and mitigation into their political agenda, ongoing government schemes and practical actions. The district Administration of Chitrakoot also developed a District Climate Resilient Plan in April 2019 to integrate climate resilient actions in to district level planning.

Chitrakoot district is part of the larger Bundelkhand region, which is among one of the drought-prone and least-developed regions in India. Numerous studies have been undertaken to understand the underlying causes of poverty and barriers to development. A special package was announced by the Indian government specifically for this region, called the Bundelkhand package.[13] The package follows a multi-sectoral approach, focusing on investments in critical infrastructure for improving agriculture productivity and the livelihoods of disadvantaged families. Drought-proofing infrastructure has been created to improve the coping capacities of the communities in the area.

Climate-resilient infrastructure like farm ponds, earthen bunds and so on are also being built across the country through the world's largest employment guarantee programme, Mahatma Gandhi National Rural Employment Guarantee Programme (MGNREGS). Chitrakoot is covered as part of the programme.

NGO initiatives: NGOs, both local and international, work in the region to address issues of water, agriculture, migration and human trafficking.

Individual/community measures: today in Chitrakoot, agriculture is largely rainfed as dug wells and borewells either don't hold groundwater throughout the year and/or are expensive to set up. Depending on the availability of water, farmers have adopted different farming systems. Under rainfed conditions, farmers prefer to do cereal cultivation with agroforestry, whereas under irrigated conditions, agroforestry is replaced with vegetables and orchards. Those who have farmlands on the riverside mainly opt for vegetable cultivation.

Loss and damage beyond adaptation

The increased frequency of drought has changed farming patterns. Now, the irrigated winter crop (and not the rainfed kharif) is the main cropping season in the entire Bundelkhand region, including Chitrakoot district. Earlier, many millets such as Jowar, Bajra, Reuncha, Sanva, Kakun were grown in Kharif season, but these are no longer cultivated by farmers. Farmers have largely shifted to monocropping. Loss of crop

12 https://khabarlahariya.org/loan-waiver-crisis-banda-mahoba-farmer-suicides/

13 National Rainfed Area Authority, Planning Commission, Government of India (2007) Impact of Bundelkhand Special Package for Drought Mitigation. https://agricoop.nic.in/sites/default/files/Bundelkhand_Package_0.pdf

diversity has affected dietary diversity and accentuated existing malnutrition and micronutrient deficiency among children, adolescent girls, pregnant and lactating women.

The flash floods in the district result in L&D to housing infrastructure, especially for poor people living in mud houses in low-lying areas. While they stay in makeshift shelters, such as schools, until the flood water recedes, after that families have to fend for themselves. The government has a programme to provide *pucca* housing (solid and permanent housing) to all landless people. Up to 2019, 39,000 people had been identified for support under the programme.[14] However, in reality, the problem is much larger than this, with not all landless or people without permanent housing being aware of the programme. They have therefore not enrolled. Flash floods also cause deaths in the district each year.

Another impact of prolonged droughts is that the youths are not interested in farming. Mass migration to big cities to earn more money has become a common phenomenon in Chitrakoot. While this results in a loss of culture and traditional knowledge, it also pushes many poor to work in exploitative and sometimes inhuman conditions.

However, apart from the anecdotal references given above, there is no district-level data available on the financial valuation of L&D. At the country level, a report[15] estimated L&D from extreme events at US$5–6 billion per annum between 2015 and 2030. The study further shared that the country would need an additional US$1 trillion between 2015–2030 to adapt to the adverse impacts of climate change. Total government spending on developing capacity and adaptation in India has grown consistently, with US$91.8 billion being spent on adaptation in 2013–14 alone. However, this spending would need to reach US$360 billion (in 2005 prices) by 2030 to address climate change impacts on the population.

Support needed in future

Addressing climate change effectively is urgent. The communities affected by the impacts of climate change will face increased vulnerabilities in coming years and they need to be educated and equipped with effective adaptive measures.

A new method that can help address multiple climate change concerns is composite risk assessment and adaptation planning. This enables a geographically explicit estimation of probable hazard risk, vulnerability and the associated economic risks. Risk prioritisation by hazard, elements at risk and location can then be undertaken, assisting in creating evidence-based investment and regional, rural and urban development policies. This then builds a bridge between public agencies, communities and the private sector.[16]

Lessons learned

Chitrakoot district has little localised information about climate variables, making it difficult to provide area-specific information to villages for effective adaptation measures. There are two separate institutions; one for declaring drought and flood and another that generates hydrological and climatic information. The two agencies lack inter-departmental connections. The district administration lacks the capacity to address climate change issues effectively. Climate resilience actions are not designed in consultation with communities. Thus, they lack local relevance and community ownership, posing a threat to the sustainability of any proposed solutions.

14 Lahariya, K (11 November 2009) The Yearly Loss of Homes and Lives in Bundelkhand Due to Floods is Getting No One's Attention. https://www.news18.com/news/india/the-yearly-loss-of-homes-and-lives-in-bundelkhand-due-to-floods-is-getting-no-ones-attention-2377327.html

15 Garg, A, Mishra,V and Dholakia, H (2015) Climate Change and India: Adaptation Gap - A Preliminary Assessment. Indian Institute of Management Ahmedabad (IIMA) W.P. No. 2015-11-01.

16 Gujarat State Disaster Management Authority and TARU (2005) Hazard Risk and Vulnerability Atlas (HRVA). Gujarat

The experience of various agricultural initiatives in Bundelkhand has shown that to address issues related to agriculture, there needs to be a combination of efficient water management/harvesting techniques, farmer-level interventions to make informed crop and seed choices, as well as cropping practices. These should be supplemented with effective customisation and coordination among government programmes.[17]

Similar multi-stakeholder initiatives involving district administration, technical agencies, NGOs and local communities can go a long way to enhance the coping capacities of local communities to climate change.

Synopsis

Chitrakoot is exposed to heat stress and recurrent droughts, caused by climate change. The resulting dryness has led to a severe drinking water crisis, frequent forest fires and loss of biodiversity. Crop loss in drought years leads to distress migration and forces the local Kol community to work in stone mines under exploitative conditions. Women are sexually exploited by landowners and mining industry contractors, locally known as *Dadus*. The continued climate crisis is pushing poor people into a vicious cycle of debt and unending exploitation.

17 District Climate Resilience Plan of Chitrakoot, op cit, p.23.

Infrastructure devastation and social loss: the impact of glacial flooding in Guma and Dzomi villages, Punakha, Bhutan

Authors: Kinzang Gyeltsho, Tshering Lhamo and Warefta-E-Murshed
Gross International Nature



Geography	Least developed countries; Asia; land-locked; eastern Himalayas
Location	Punakha, Bhutan
Climate hazards	**Slow-onset:** rising temperatures, erratic rainfall, delayed monsoon rains **Rapid-onset:** flooding
Vulnerable groups	Less educated villages, more recent arrivals, women, children, farmers
Response mechanism	**Anticipatory:** early warning systems (EWS), reducing glacial lake volumes, simulation exercise **Survival:** adaptable crop varieties, traditional methods **Recovery:** land compensation
Innovations	Upgrading the existing EWS

Context

Punakha is situated about 1,500m above sea level. The district was once the capital of Bhutan and is the revered home to the Punatsangchhu River, one of Bhutan's major river systems. This case study covers the Guma and Dzomi villages of Punakha. Guma is a clustered settlement near the Mochhu River, covering 37km^2 at 1,200–2,200m above sea level. The village is in the sub-tropical zone, consisting of chirpine and mixed warm broadleaf forest. There are 4,288 people in 816 households.

Dzomi Gewog, near the Phochu River, covers 21.92km^2 at an altitude of 1,200–2,400m above sea level. There are 257 households with a population of about 1,350 people. Since both areas are close to Phochhu, they are susceptible to flash floods and glacial lake outburst floods (GLOF).

In the earlier days, erratic rainfall and water scarcity were rare in the locality. The temperature in the two areas was relatively low, and irrigation water (sourced from rain) was sufficient for a year. Consequently, the rise in temperature and extreme rainfall events raised the water levels of both Phochhu and Mochhu. For instance, in 1990 the average highest temperature was 29.5°C, increasing to 31.9°C by 2017.[1] As a result, riverbanks and agricultural lands near the rivers got submerged, and most of the glaciers retreated, rapidly increasing the occurrence of GLOF and imposing a threat to human settlements. The International Centre for Integrated Mountain Development (ICIMOD) has identified 2,674 glacial lakes in Bhutan, of which 500 lakes feed the Phochhu, Mochhu, and Chamkharchhu.[2]

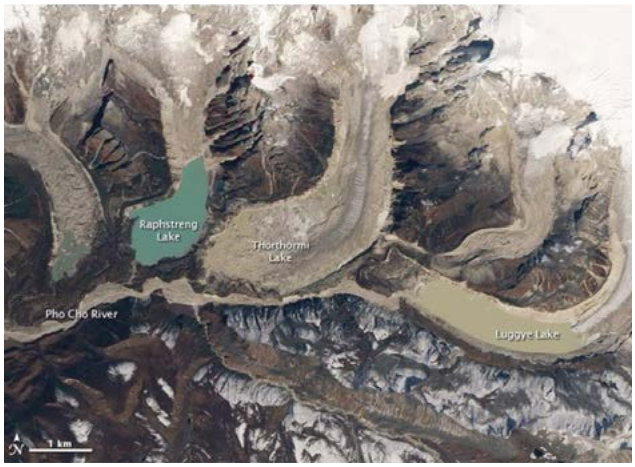


Figure 1: the Thorthormi glacier and its supraglacier lakes joining the Phocchu

Source: NASA Earth Observatory image by Robert Simmon

Thorthormi glacier had no subsidiary lakes and ponds in the early 1950s. Today, there are numerous supraglacial interconnected lakes, as shown in Figure 1. Currently, Thorthormi Lake has the highest potential of out-bursting and washing away the downstream communities.[3] Between 1950 and 2021, places near these rivers witnessed five major GLOF events. These events led to the displacement and resettlement of people to other areas; and destroyed lands that were once scenic picnic spots and agricultural fields. Because of climatic alterations, villagers in this area are under constant threat of flooding and inaccessibility to safe drinking water, and unable to obtain their previous annual crop yield.

Impacts

Punakha district produced 144,282 metric tonnes of rice between 2005 and 2020. The area has had the highest levels of rice production in the country and is known as 'The Rice Bowl of Bhutan'. Guma and Dzomi villages are part of this high rice-producing district. The region has been solely dependent on paddy cultivation for income generation, but now, water scarcity and irregular rainfall have deteriorated yield quality and exacerbated pest infestation. As a result, villagers have been compelled to change their cultivation patterns.

1 National Center for Hydrology and Meteorology (2018) Climate Data Book of Bhutan. Weather and Climate Service Division, Royal Government of Bhuta n, Thimphu.

2 Mool, PK, Wangda, D, Bajracharya, SR, Joshi, SP, Kunzang, K and Gurung, DR (2001) Inventory of Glaciers, Glacial Lakes and Glacial Lake Outburst Floods Monitoring and Early Warning Systems in the Hindu Kush-Himalayan Region, Bhutan. International Center for Integrated Mountain Development, Kathma ndu, Nepal.

3 Singh, S (2009) *The Cost of Climate Change: The Story of Thorthorimi Lake in Bhutan. Living Himalayas Initiative.* World Wildlife Fund.

Dzongs (fortresses) in Bhutan, have a significant administrative, cultural and religious significance. They symbolise the unity and tranquility of the area and are considered a precious inheritance from forefathers. The 1994 GLOF washed away almost half of the structure of the Dzong in Punakha, having a significant effect on people. In a 2012 study, when asked about the 1994 GLOF, close to 90% of households mentioned the washing away of Punakha Dzong.[4] The 1994 GLOF killed 21 people and heavily destroyed the Punakha Dzong, police complex, plantation forest, and paddy fields.[5] Eyewitnesses reportedly saw fresh logs being washed away and hundreds of fishes dying. The GLOF led to the destruction of forest and marine ecosystems and the fish population took nearly a decade to replenish. The outburst of Lugge Lake washed away 12 houses and covered 1,800 acres of land with silt and sand.

These destructions have caused a magnitude of economic loss, social disharmony and physiological harm to the people. The Lemthang Lake outburst of 1960 resulted in four dead horses, engulfed four cantilever bridges, destroyed a 1km trail, and damaged one acre (43,560sq ft) of land.[6] The 1987 GLOF mainly affected the businesses of Punakha. Two shops experienced irreparable damage of 300,000 ngultrum (US$4,045), and most of the shops and residents had to be evacuated. These events threatened people's lives and their property was subjected to theft and robbery. In the 1994 GLOF, one person was killed, and 16 people went missing. The Dzong was left untouched but the flood damaged the Dzongchhung monastery. Although prominent relics and paintings were saved, the monastery still lost precious statues and religious objects to the flood. In addition, the flood damaged the suspension bridge, police complex, and paddy fields along the riverbanks.[7]

Amid these crises, the fourth King of Bhutan and the Royal government delivered a prompt response. His Majesty immediately visited the flood affected areas and granted 800,000 ngultrum (US$24,191) as a welfare grant to the affected people. The King sanctioned the construction of a 100-metre bridge amounting to 12.5 million ngultrum (US$377,986), and supervised the installation of natural barriers and retention walls to prevent future damages to the areas. The flood victims' family members were provided with monetary assistance to conduct the funeral rites.

Compounding risks/impacts created

Most villagers in Guma and Dzomi are illiterate and were unaware of the state disaster policies and the designation of hazard zonation maps in their localities. For instance, when questioned about the hazard zonation map of their community in the case of GLOFs, the villagers — which included shopkeepers, farmers, and housewives — were unable to respond. However, villagers with greater levels of formal education, especially civil servants, were aware of this invaluable information. The lack of adequate education and awareness among the villagers could be an existing vulnerability that could ultimately exacerbate climate impact in the regions.

A glacial lake outburst is a low-frequency event and its risks are often neglected with time. Therefore, assessing the preparedness of vulnerable communities is crucial to the success of future disaster mitigation. An examination of past experiences of villagers from the case study areas and the disaster management training they received, showed that the duration of residency in the area positively influenced their preparedness for GLOF disasters. The residents in Guma and Dzomi who have lived in the villages for more than 50 years were relatively better prepared than those who had been in the area for less than ten years.

4 Kusters, K and Wangdi, N (2013) The costs of a daptation: Changes in water availability and Farmers' responses In Punakha district, Bhuta n. *International Journal of Global Warming*, 5(4), 387–389. doi:10.1504/IJGW.2013.057287

5 Watanabe and Rothacher (1996) The 1994 Lugge Tsho Glacial Lake Outburst Flood, Bhutan Himalaya. *Mountain Research and Development,* 16 (1), 77–81. doi : 0.2307/3673897

6 Gurung, DR, Khanal, NR, Bajracharya, SR, Tsering, K, Joshi, S, Tshering, P, Chhetri, LK, Lotay, Y and Penjor, T (2017) Lemthang Tsho Glacial Lake Outburst Flood (GLOF) in Bhutan: Cause and Impact. *Geoenvironmental Disasters*, 4(1), 1–13.

7 National Centre for Hydrology and Meteorology (2017) Compendium of Climate and Hydrological Extremes in Bhutan since 1968, p.131. Thimphu.

Additionally, new residents received no training on disaster preparedness, or information on the safe evacuation areas in the event of GLOF disasters. Hence, they were less prepared for sudden events than the residents living there for a longer period. Interviews conducted with students revealed that awareness was raised at the school with a selective group of students.

The lack of inclusive movement in the areas is another existing vulnerability that has the potential to exacerbate climate impacts in the future. Finally, the upheaval caused by the COVID-19 pandemic has shifted people's focus to the virus, making people more complacent about GLOF and increasing their vulnerability to an impending disaster.

Vulnerabilities/impacts by compounding risks

The people of Guma and Dzomi are solely dependent on their paddy yield. After a GLOF event, the water supply becomes cloudy and contaminated with sediment. When water becomes opaque, it slows down the process of photosynthesis, thus impacting the quality and quantity of crop yields.

Local communities living in the uphill regions were unable to access health facilities on time after the GLOF onset, with difficult terrain and scattered settlements causing a delay in emergency response. The geographical landscapes of the villages make it difficult to travel without accessing wooden suspension bridges.

Often the bridges connecting localities and motorable roads are the first to be impacted by GLOFs. When the flood event lasts for weeks, children cannot attend school, and there is a disruption in public services. If people cannot fix contaminated water sources within the locality, they lose access to basic amenities. The community members are then forced to evacuate to higher grounds into makeshift houses for their safety.

Displacement of people from the flood-prone native lands to other areas imposes severe social and economic problems. This is especially true for mothers and children, who have to travel long distances to access health facilities and education. As per the local leader of the Guma Gewog, people were offered the alternative to move to another low flood-risk area. However, they opted not to relocate as the compensated land did not cover their loss. In such a scenario, although the risk of staying at their village is high, the communities do not wish to leave behind their precious homeland, which they inherited from their forefathers. Bhutanese people often consider their land as a treasure trove. Thus, the custom of passing the same piece of land to the next generation is important. These traits, land and houses, hold a magnitude of sentimental value for the people. Therefore, they are often reluctant to leave their home and land behind and move to another community.

Because of this, the Royal Government of Bhutan has not forcibly displaced the people against their will. Instead, it has installed effective early warning systems to give people ample time to evacuate during such floods. During the GLOF and post-flood events, people were supported by the government and the king of Bhutan.

Adaptation measures

Conventional adaptation measures include:[8]

- **Installation of GLOF Early Warning System (EWS) 2010–2011**

  The EWS contains four automated water level stations, 17 sirens and three fully functional weather stations. When it was installed, there was an extensive community awareness programme on GLOF

8 Mool, PK, Wangda, D, Bajracharya, SR, Joshi, SP, Kunzang, K, and Gurung, DR, op cit.

red zone areas and safe evacuation sites in all vulnerable communities, based on GLOF hazard zonation mapping. Every day for 24 hours, two specialists monitor the Flood Warning Control Station connected to the Flood Warning System of Bhutan. The station regularly transfers data to the neighbouring stations of Assam and West Bengal. Additionally, there is an interim manual EWS for the 21 most vulnerable groups in the Punakha-Wangdue valley. Therefore, the villagers can pinpoint hazardous sites and relocate out of harm's way.

- **Reducing the volume of glacier lakes 1994, 2009**

  The volume of the glacier lakes was reduced between 1994 and 2009 using the following methods:

  1. Controlled breaching
  2. Construction of exit control structures
  3. Pumping or draining water out from the lakes
  4. Tunnelling through moraine barriers or under ice dams.

- **Simulation exercise on Glacial Lake Outburst Flood (GLOF) at Punakha Hospital 2019 — Ministry of Health**

  A three-day mock simulation on the public health emergency response was held at the mass casualty station. The drill examined:

  1. Preparedness and response mechanisms
  2. Reinforcement of roles and responsibilities in response to a public health emergency
  3. Limitations and scope for development in a public health emergency
  4. Hospital response mechanisms
  5. Effectiveness of communication between national-level Health Emergency Operation Centers and other stakeholders.

- **Programmes for coping with impacts of climate stressors**

  In the agriculture sector, farmers were provided with crop varieties adaptable to new climate conditions, pests and diseases. The district agriculture office has introduced millets and buckwheat to curb the impacts of fall armyworm (*Spodoptera frugiperda*) infestation and rice blast. The villagers use pesticides such as Cypermethrin, Chlorophylie, tricyclazole and foliar spray under the strict supervision and guidance of the Dzongkhag Agriculture Department.

Traditional adaptive measures: all houses were built on high ground and off the riverbank to avoid future displacement. Additionally, villagers use a peculiar smell of mud to predict floods. The community also monitors the unusual behaviour of livestock, since they are more sensitive than humans to vibrations and can hear an approaching flood from a distance.

The community is guided by spiritual beliefs. People consider natural calamities, such as floods, as a direct implication of the deity's wrath. Therefore, to prevent such occurrences, people gather to conduct rituals to appease the deity. The ceremonies are believed to prevent disasters, bring in timely rain and improve the annual yield.

Loss and damage beyond adaptation

The flood on 7 October 1994 was caused by the fragmented burst from Lugge Tsho (glacial lake) of eastern Lunana, leaving a trail of death and devastation in its wake, and damaging the Dzongchung (small fortress) of Punakha Dzong.[9] On October 20–23 1994, 91 households were severely damaged by the flood in the Lunana range.[10] Twelve homes were destroyed, five water mills were completely washed away, and 816 acres of dry land and 965 acres of meadows were eroded and partly covered with silt and sand.[11] As the people in the area were solely dependent on the yak for sustenance, the erosion of pasture land severely impacted their livelihood. Moreover, 16 yaks disappeared in the flood. The community lost six tonnes of food.

In Punakha, people practise terrace farming. They cultivate rice by harvesting the rainwater from nearby streams. The paddy fields require sufficient water in irrigation canals. Water is harvested in the rainy season and shared by households. However, erratic rainfall and the delay of monsoon rainfall have made it increasingly difficult to access adequate water for irrigation over the last two decades.

More than 12% of the people in the region were permanently affected by the GLOF. These include the farmers who permanently lost part of their agricultural lands, as they were covered with a fine layer of river sand and stones, or were washed away. The government compensated at least half of the farmers who lost their land, but many of those affected in the region had to look for additional income. Today, farmers are not very concerned about the future flood risk. They point to several measures the government has taken to decrease the risk. For example, by artificially lowering the water level of the Thorthormi glacial lake, and a national-level awareness campaign to prepare people for disasters.

In recent years, farmers have adopted new measures to increase their water supply. They rent water pumps for their irrigation canals. Each usage costs about US$160 per acre per season, whereas purchasing access to water in other villages costs US$70 per acre per season.

There are also non-economic costs. Villagers have mentioned that sharing water facilities has increased tensions between village settlements. Various media outlets have also reported that vandalism of adaptation measures frequently occurs at Punakha. For instance, a village breaks the water-sharing agreement by diverting an irrigation stream to their fields at night.

Support needed in future

The degree of awareness and preparedness of people in Guma and Dzomi about glacial lake outburst floods is vital in preventing L&D from GLOFs. The public has learned about GLOFs through direct experience, training, word of mouth and various media outlets like *Bhutan Broadcasting Services* and *Kuensel*. Meanwhile, new residents in the study areas are at greater risk and require immediate induction courses on GLOF awareness and preparedness.

Regardless of the high perception of GLOF in Guma and Dzomi, there is a significant difference in the knowledge of the science behind it. Many illiterate villagers are unable to justify the occurrence of GLOF. The failure to grasp the cause and effect of GLOF prevents the frontline communities from coping with the existing and anticipated climate losses and damages. Additionally, experts in the field of GLOF recommend installation of the early warning systems on all mobile devices for quick and extensive outreach, development of 'Live Riverflow Forecast' web application and regular upgrades of meteorology station equipment.

9 Watanabe and Rothacher, op cit.

10 Geological Survey of Bhutan (1994) Preliminary Report on the Investigation of Glacial Lakes at Pho Chhu Source and the Assessment of Flood Affected Areas in Lunana. Geological Survey of Bhutan, Bhuta n.

11 Singh, S, op cit.

Traditional adaptation measures have proven to be helpful in times of a GLOF event. A collaboration between the local government and technical experts to create a conducive environment for modern and traditional adaptation measures would further help the community prevent L&D.

Lessons learned

The villagers of Guma and Dzomi cannot understand the science behind GLOF and require extensive training on its cause and effect. The scientific knowledge acquired would allow them to fully participate in mitigation and adaptation activities, thus reducing L&D.

If community involvement is encouraged in GLOF-related projects, policy-making and implementation would significantly improve awareness and preparedness. Similarly, establishing a community-based hazard watch group and hazard management committee is very important for outcomes to be effective and sustainable.

Regular follow-ups on GLOF risk management in the two villages would also help develop adaptation strategies to climate change-induced L&D. Finally, upgrading the EWS with new and improved technologies would help prevent L&D by climate stressors.

Synopsis

The changing climatic conditions and variabilities have imposed a heavy burden on the people of Guma and Dzomi of Punakha District. Located in the downstream area of about eight potentially hazardous lakes, people in these regions are constantly threatened by GLOF events. The 1994 GLOF inflicted heavy damage to the infrastructure and created social chaos. The 1994 flood served as a wake-up call, and the country is now mitigating the issue with proper research and equipment. However, with the looming threat of climate change, the communities will always be susceptible to these disasters.

Displacement and inequality: the impact of river flooding in Kasese District, Uganda

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Geography	Least developed countries; Africa; land-locked
Location	Kasese District, Uganda
Climate hazards	**Slow-onset:** rising temperatures; **Rapid-onset:** flooding
Vulnerable groups	Women, children
Response mechanism	**Anticipatory:** riverbank tree planting, flood defences, early warning system **Survival:** water level monitoring, community activities
Innovations	Community disaster management committee; trained community teams monitoring early warning signs of disaster

Context

Kasese District, one of 135 districts in Uganda,[1] is located in the western region of Uganda at 00°11'N 30°05'E. Kasese District is bordered by the Districts of Kabarole to the northeast and east, Bundibugyo to the northwest, Kamwenge to the southeast, Bushenyi to the south and the Democratic Republic of Congo to the west. It has an area of 3,389.6km^2, of which only 1,076.6km^2 (37%) is available for habitation and cultivation. This is because a large part of the area is occupied by water bodies, wildlife conservation areas, and nature or forest reserves, as well as government projects such as irrigation sub-county schemes and prison farms.[2] In view of this, the population of Kasese District is concentrated in a narrow corridor of land running between the Rwenzori Mountains and the Western Rift Valley. Subsequently, there is high population pressure on the available land to sustain the growing population. This is a factor in the widespread environmental degradation of the district.

Kasese District has five major rivers (Lhubiriha, Mubuku, Nyamwamba, Nyamugasani and Sebwe). The rivers are fed by glaciers from the Mountains of the Moon (Rwenzori Mountain) and flow to Lake Albert in Albertine Rift. Kasese District has a population of nearly seven million, 2% of the total national population.[3] More than 85% of the people in the district are involved in agriculture, most of them as peasant farmers who depend on subsistence farming for their livelihoods. Other livelihood activities include mining, tourism and fisheries.

Climate change is affecting the area in different ways. According to research studies, the most visible impact of climate change is the rapid loss of the ice field, which shrunk from 6.5km^2 in 1906, to less than 1km^2 in 2003. It could completely disappear before the end of this decade.[4]

Impacts

Floods in Kasese have impacted infrastructure, industry, homes, communities, and religious, cultural and heritage sites.

Since 2013, Kasese District in the Rwenzori sub-region has been grappling with floods that often cause riverbanks to burst.[5] They have occurred every year in May and June, destroying crops and livestock, and leading to unemployment, poverty and hunger, while destroying livelihoods and causing food insecurity in the district.[6] In 2020 alone, 24,760 houses and an estimated 173,000 people were affected by the floods, forcing them to relocate to temporary shelters for safety.[7]

The floods' destruction of homes forced people to take shelter in camps. This large-scale displacement has resulted in overcrowding, which in turn has led to gender inequalities, drug and alcohol abuse and gender-based violence. Floods have destroyed infrastructure including schools, leaving children out of

1 Ministry of Local Government, Republic of Uganda. Districts. https://molg.go.ug/districts

2 Republic of Uganda (2016) Kasese District Hazard, Risk and Vulnerability Profile. Department of Relief, Disaster Preparedness and Management, Kampala. https://www.necoc-opm.go.ug/HzWestern/Kasese%20District%20HRV%20Profile.pdf

3 Uganda Bureau of Statistics (2017) The National Population and Housing Census 2014 — Area Specific Profile Series. UBOS, Kampala. https://www.ubos.org/wp-content/uploads/publications/2014CensusProfiles/KASESE.pdf

4 Uchoa, Pablo (30 March 2021) Uganda climate change: The people under threat from a melting glacier, *BBC News*. https://www.bbc.com/news/world-africa-56526631

5 Climate Action Network Uganda (20 March 2021) Kasese Residents Call for Urgent Action on Flood Risks. https://can.ug/2021/03/20/kasese-residents-call-for-urgent-action-on-flood-risk/

6 Ninsiima, E and Basiime, F (28 June 2018) Hunger looms in aftermath of floods. ReliefWeb. https://reliefweb.int/report/uganda/hunger-looms-aftermath-floods

7 Okiror, S (16 May 2020) 'People are desperate': floods and rock slides devastate western Uganda. The Guardian, London. https://www.theguardian.com/global-development/2020/may/16/people-are-desperate-floods-and-rock-slides-devastate-western-uganda

education and causing pregnancies among young girls who turned to the sex trade for survival.[8] The destruction of roads has led to many not being able to access healthcare facilities and markets. The floods have further polluted the waters and waterborne diseases have been on the rise. These are causing serious health, nutritional and economic challenges to the communities.

The floods also impact Kasese District's rich eco-systems that cover a wide range of protected areas, ravaging natural habitats that are home to wildlife, livestock and plant species. The district has a UNESCO World Heritage Site, Rwenzori Mountains National Park, and sensitive lakes and rivers, most of which pour their waters into Lake Victoria — the largest freshwater lake in Africa and the second largest in the world.[9] The floods have resulted in stagnant water, attracting hippopotamuses. Their danger to residents has prompted their killings by the Uganda Wildlife Authority.[10]

Compounding risks/impacts created

The floods have submerged grasslands under water, resulting in a lack of grazing ground and shortage of animal fodder. This has led to animal malnutrition and heavy losses to the district's livestock industry. The worst impact of floods are livestock casualties due to areas getting submerged or livestock being washed away. Poultry houses are also submerged, killing the birds, while goats and cows are frequently drowned or left with disabilities after being injured in the floods.

Forests are also adversely affected, with many old trees falling, and young ones dying after their roots are damaged.

Vulnerabilities/impacts by compounding risks

Women, who are majorly employed in the agriculture sector in Uganda (76% versus 62% of men),[11] have lost their agricultural jobs and goods, resulting in income inequality and poverty.

Children are not able to access schools, with the destruction of road networks and school buildings. Health centres and hospitals have also been destroyed, creating challenges for people in accessing health care. In the settlement camps, there are outbreaks of hygiene-related diseases like cholera, due to the lack of latrines and the use of contaminated water. Preventive measures to COVID-19 are also missing in all settlement camps. Due to overcrowding, social distancing and hand washing are hard to implement. With children unable to go to school, there are high levels of teenage pregnancy and early marriages in camps.

The floods also destroyed the Kiwa Heritage site — where rituals are performed and gods are worshipped by a certain group of traditionalists — as well as a community museum located at the site. Grass thatched structures used as dressing shelters for those soaking themselves in the hot water for medicinal purposes were also destroyed, together with the fish ponds and pool table. This caused a direct loss of tourism jobs and livelihood.

8 Bagonza, RA (2014) Gender and vulnerability to disasters and disaster/climate risk management in Uganda: a participatory characterisation. UNDP, Uganda

9 WWF (29 October 2015) WWF and partners address causes of recurrent flooding in Kasese District through improved catchment management practice. https://wwf.panda.org/wwf_news/?255492/WWF-and-partners-address-causes-of-recurrent-flooding-in-Kasese-District-through-improved-catchment-management-practice

10 The Independent (17 February 2021) UWA rangers kill stray hippo in Kasese. https://www.independent.co.ug/uwa-rangers-kill-stray-hippo-in-kasese/

11 MAAIF (26 September 2019) Gender mainstreaming prioritized in Agriculture Sector Strategic Plan. https://www.agriculture.go.ug/gender-mainstreaming-prioritized-in-agriculture-sector-strategic-plan/

Adaptation measures

Some of the structural flood mitigation measures identified in Kasese District include riverbank tree planting, a flood wall (raised stone concrete riverbank wall), de-silting/channelling, enhancing natural and artificial levees, and creating floodways for large long-time recurring floods. Catchment-wide interventions are effective to decrease surface run-off and soil erosion and therefore to reduce flood peak.

There have also been non-structural measures comprising risk acceptance and risk reduction strategies. These include awareness, land-use planning, construction, structure management codes, soil management and acquisition policies, insurance, public information actions, emergency systems and post-catastrophe recovery. These are all less expensive and effective ways to mitigate flood-related problems.

Communities have also created disaster management committees, manned by volunteers to sensitise residents to protect rivers and their tributaries through restoration and environmental activities. They have started planting trees along riverbanks to help prevent future flooding. And to control silting and erosion, people have campaigned to end human activity along the riverbanks, including unstainable cultivation, animal grazing and sand mining. Trained community teams monitor water levels to detect any early warning signs of disaster and warn the communities accordingly.

Farmers are also practising good cultivation practices. With the help of partners such as Uganda Red Cross, AIFE-Uganda, Government of Uganda, CARE Uganda, UNICEF and so on, residents have constructed community gabions and created a community early warning system through a public-address system. They have also volunteered to clean the river of waste, and own a community radio to help share important information.

Other measures include the construction of flood control dams and diversion channels, removing or stopping building houses in the worst flood hit areas, and building raised houses to adapt to flooding.

These measures have reduced the loss of lives, crops and animals, and allowed the population to cope with flooding in Kasese.

Loss and damage beyond adaptation

The loss of jobs and incomes has remained common in Kasese District, even with the mitigation measures in place. This is due to the fact that most of the people's capital has been lost in recurring floods.

The communities have continued to lose lives to floods. In 2020 alone, 11 people died and others were injured and hospitalised.[12] The population is also still being displaced, while houses are destroyed and livestock is lost. The temperatures in the area are still increasing, the glaciers on the Mountain of the Moon continue to melt, and forest degradation and loss of biodiversity continue to happen. Floods also still destroy items of cultural significance, such as the Kiwa Heritage Site, which is important for cultural and religious purposes.

Some data about the cost of repairing infrastructure is available. Disaster relief expenditure by the International Federation of Red Cross amounted to 293,166 Swiss francs (US$316,218).[13] The costs of repairing major bridges and road networks was estimated at 5 billion shillings (approx. US$2 million) in

12 Thawite, J (23 May 2020) Kasese floods death toll now 11. ReliefWeb. https://reliefweb.int/report/uganda/kasese-floods-death-toll-now-11

13 Republic of Uganda (2015) Economic Assessment of the Impacts of Climate Change in Uganda. National Level Assessment: Infrastructure Sector report. Ministry of Water and Environment, Climate Change Team. https://cdkn.org/wp-content/uploads/2015/12/Uganda_CC-Economics_Infrastructure-Sector.pdf

the aftermath of the floods.[14] This estimate rose to 35 billion shillings (US$13.7 million).[15] Damage to the hospital included the loss of the mortuary, the pediatric ward and an X-ray machine, for which funds were requested from the Department of Health.[16]

Support needed in future

Development partners and government should allocate more resources to scale up best practices in the district, such as bank tree planting, flood walls and so on. The approach should change from short-term relief to long-term capacity building.

Young people should be involved in the efforts, to promote long-term change in practices and communities, and there should be more support for communication networks, including community radios and alarm systems.

In all cases, the local community must be at the centre of all efforts to allow for the easy dissemination of approaches and practices. Management plans and by-laws should be put in place for better flood management.

Lessons learned

- Environmentally friendly policies must be adopted to include climate change, flood screening and budget tagging
- To enhance protection against flood risks and offer support in the case of flood-related damage, government, development partners and local communities should create and expand social security networks to help those affected
- In the event of floods, government and development partners should establish a fund to support necessary resettlements and rehabilitation measures
- Timely early warning systems and other flood interventions should be put in place and enhanced to improve the flood resilience of the Kasese people
- Government, development partners and communities should organise systematic flood risk analysis and promote flood risk management
- The communities must be trained on how to manage floods and the environment, and contribute to restoration activities and other flood reduction interventions.

Synopsis

Kasese District is located in the western region of Uganda, with over 70% of the population engaged in agriculture. The district has five major rivers (Lhubiriha, Mubuku, Nyamwamba, Nyamugasani and Sebwe) that seasonally burst their banks, causing floods which destroy agricultural fields, infrastructure, and cultural and heritage sites. This is a result of human activity along the riverbanks, including unsustainable cultivation, animal grazing and sand mining. The communities are however responding by restoring the degraded riverbanks and increasing community awareness in a bid to reduce loss and damage.

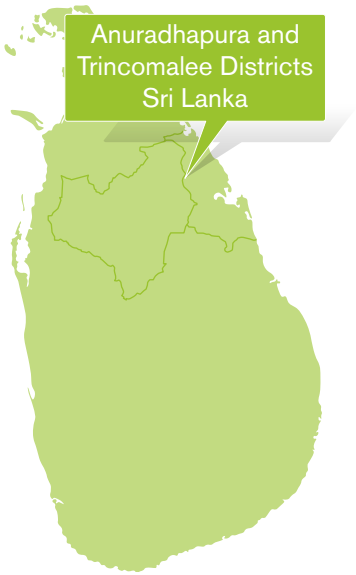
14 Ibid.

15 Markandya, A, Taylor, T, Kajubi, L and Cunliffe, S (2015) Economic Assessment of the Impacts of Climate Change in Uganda. National Level Assessment: Infrastructure Sector report. Ministry of Water and Environment, Climate Change Department, The Republic of Uganda.

16 Republic of Uganda (2017) Economic Assessment of the Impacts of Climate Change in Uganda. Ministry of Water and Environment, Climate Change Team. https://cdkn.org/wp-content/uploads/2015/12/Uganda_CC-economics_Final-Report2.pdf

Left behind: the impact of climate migration on communities in Anuradhapura and Trincomalee districts, Sri Lanka

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SLYCAN Trust



Geography	South Asia; island
Location	Anuradhapura and Trincomalee, Sri Lanka
Climate hazards	**Slow-onset:** temperature rise, rainfall variations, drought, salinity in lowland soils **Rapid-onset:** occasional floods
Vulnerable groups	Climate migrants, women, children, young people, older persons, people with special needs
Response mechanism	**Anticipatory:** tank-based irrigation, land-sharing **Survival:** government relief programmes, disaster insurance

Context

The case study area includes 16 villages in the divisional secretariat divisions of Gomarankadawela, Horowpathana, Ipalogama, and Morawewa, in the districts of Anuradhapura and Trincomalee in Sri Lanka, South Asia (see Figure 1). Both districts are located in the dry zone of the island and have a high agricultural output, providing almost one fifth of the country's total paddy production, despite being home to only 6.3% of the population.[1]



Figure 1: the districts of Anuradhapura (marked brown) and Trincomalee (marked green) in the Dry Zone of Sri Lanka.

Credit: SLYCAN Trust/Creative Commons

Sri Lanka, particularly the dry zone, is primarily affected by rising day- and night-time temperatures, and shifting rainfall patterns. Observed average temperatures have increased by around 0.8°C over the course of the 20th century, with temperature rises accelerating toward the end of the century. There has also been a general trend of reduced annual rainfall since the second half of the 20th century, with increasing temporal and spatial variation.[2]

Temperature rise and rainfall variations in Anuradhapura and Trincomalee result in frequent drought, prolonged water scarcity, occasional floods, salinity development in lowland soils, soil degradation, high winds and loss of agricultural productivity, including for key staples such as paddy. Other impacts causing loss and damage (L&D) include pests and diseases, invasive alien species, and human-wildlife conflict. Climate stressors also result in decreasing fish populations and adversely affect livestock.[3]

In both districts, a large percentage of the workforce is employed in agriculture, with 46.7% in Anuradhapura and 24.6% in Trincomalee District. Due to cultural and socioeconomic factors, labour force participation is much higher for men (77.3% in Anuradhapura, 73.5% in Trincomalee) than for women (42% and 20%, respectively).[4]

This case study is based on an in-depth survey conducted with 50 people in four villages in Trincomalee District, as well as interviews with farmers, housewives and migrant workers. The data was further supplemented by interviews and group meetings on climate change impacts, coping strategies, adaptation measures, and the financial resilience of households. In total, more than 600 members of farming communities across 14 villages in Trincomalee and Anuradhapura district took part in this additional data collection throughout 2019–2021. In addition, consultations, workshops and interviews were conducted with stakeholders and experts from key national and local government entities, universities, research institutions, civil society organisations, the private sector, and UN agencies.[5]

1 Department of Census and Statistics, Ministry of Finance of Sri Lanka (2021) Annual National Accounts of Sri Lanka 2020 and Statistical Abstract 2020.

2 The World Bank/ADB (2020). Climate Risk Country Profile: Sri Lanka.

3 Ministry of Mahaweli Development and Environment (2015). National Adaptation Plan for Climate Change Impacts in Sri Lanka: 2016–2025.

4 Department of Census and Statistics, Ministry of Finance of Sri Lanka (2019). Sri Lanka Labour Force Survey Annual Report 2019.

5 SLYCAN Trust (2019). Climate Displacement and Internal Migration in Sri Lanka — A Case Study on Trincomalee District.

Impacts

Communities in the case study area experience economic and non-economic L&D due to droughts, erratic monsoon seasons, changes in rainfall patterns, floods, pests and diseases, and human-wildlife conflict. Virtually all surveyed households are engaged in smallholder agriculture as their main (or one of their main) sources of livelihood, and all households reported serious climate-related impacts over the past decade (see Figures 2 and 3).



Figure 2: climate impacts in the study area primarily cause losses and damages to agricultural production and impact the livelihoods of smallholder farmers

Credit: SLYCAN Trust

This disruption to livelihoods, especially those dependent on natural resources, has adverse impacts on household finances and food security. In many cases it forces individuals to migrate in search of employment, leaving their families behind. Non-economic climate-related impacts also include adverse health conditions (including from heat and water- or vector-borne diseases), groundwater depletion, and siltation. Natural ecosystems are affected as well and suffer from degradation, biodiversity loss, loss of ecosystem services, and increasing habitat degradation and encroachment, that leads to rising encounters of human-wildlife conflict.[6]

In Sri Lanka, the observed forms of climate-related human mobility include seasonal/cyclical rural-urban migration, related to drought and declining agricultural livelihoods; environmental impacts leading to internal or international migration; disaster displacement from floods and landslides; and relocation of settlements away from landslide-prone areas.[7]

Most of the households interviewed had a family member who had migrated away for an extended period of time, due to the loss of primary income based in agriculture. In most cases, the migrating family member was male and the primary income-earner in the household. They had usually migrated to Colombo or another urban centre for a period of one or two months at a time.

6 FAO (2021) Climate Change Impact on Crop Production in Sri Lanka: challenges and adaptation options.

7 SLYCAN Trust (2020). Policy Brief: Climate Change and Human Mobility in Sri Lanka — Policies, Laws, and Processes.

While migrants may face a new set of social and health issues in the host environment, families staying behind face a different set of issues. Since climate migration often goes undocumented — especially due to the slow on-set of disasters — social, cultural and health issues arising from such forms of human mobility are difficult to address. Among those staying behind, the majority did not have a steady source of income and employment, with home gardening being the most common occupation, followed by farming and small-scale businesses.

Compounding risks/impacts created

Climate impacts in the study area primarily cause L&D to agricultural production (including crop cultivation, livestock, and inland fisheries) and impact the livelihoods of rural smallholder farmers. However, these livelihoods also face non-climate-related risks such as production risks, price volatility and other market uncertainty, as well as financial and environmental risks.[8]

These threats can compound climate risks and exacerbate local vulnerabilities, including a lack of shock-responsive rural infrastructure, gaps in transport and storage infrastructure, limited financial resources, and low economic diversification, with few alternative employment and income options.[9]



Figure 3: virtually all surveyed households are engaged in smallholder agriculture as their main (or one of their main) livelihood source(s)

Credit: SLYCAN Trust

Climate change also increasingly causes a misalignment between traditional knowledge and changing weather patterns and climatic conditions, rendering traditional coping strategies less effective. Many ancient cascade tank systems have fallen into disrepair, are not being properly maintained, or suffer from siltation, salinity intrusion, and clogging from invasive alien species. This heightens the vulnerability of farming households to water scarcity, prolonged dry spells and drought.

The vulnerability of these households is also high because they usually lack financial savings, access to formal credit, and access to or knowledge about formal risk management, risk finance, and risk transfer mechanisms — particularly in the face of increasingly frequent and extreme weather events. Therefore, the increasing environmental and economic pressures push many small-scale agricultural households into 'debt traps' or 'poverty traps'. This is when they find themselves forced to take loans that they might not be able to repay if climate impacts affect their harvest.

Vulnerabilities/impacts by compounding risks

Climate-induced migration and displacement creates and compounds vulnerabilities at the individual and household level. As such, migration is not voluntary or properly planned, and migrants and their families are often unprepared for the consequences of migration. In particular, women, youth, children, the elderly, those with special needs and already marginalised groups lack the necessary coping and adaptive capacities to handle unexpected shocks and income losses, forcing them to migrate even under unfavourable circumstances and without safety nets.

8 SLYCAN Trust (2021). Discussion Brief: Climate Risk Management and Finance in Sri Lanka.

9 SLYCAN Trust (2021). Working Paper: Household Profiles and Key Indicators for Climate Risk Transfer in Sri Lanka.

Climate mobility in Sri Lanka also often exacerbates pre-existing gender-related issues. In many rural agricultural communities, women have lower access to and control over assets and resources, lower income stability, and lower technical and financial support compared to men. The migration of male family members — who are often the main income earners — may result in exposing women and children that stay behind to heightened vulnerabilities and eroding social cohesion.

If women migrate, they are often exposed to additional vulnerabilities due to a lack of familiarity and security in the host environment, highlighted by key experts in national consultations.[10] The migration of mothers can result in the heightened vulnerability of children and cause health, nutritional, developmental and behavioural problems, and can expose children to violent and abusive environments. For children and youth, dangers include neglect or abuse, nutritional deficiencies leading to stunting or wasting, lack of access to education, and emotional trauma. Women often take on additional responsibilities when their husbands migrate, creating issues surrounding mobility and immobility in the case of displacement. Gender-based violence and sexual exploitation, unsafe shelters, unsafe migration, human trafficking, duty of childcare, or supporting the elderly can cause women to face additional threats in case of migration or displacement.

Overall, climate-related migration and displacement is connected to a loss of social cohesion at the community level, as families become increasingly fragmented and untethered from their heritage and traditional way of life. Both origin communities and host communities can be affected by this.

Adaptation measures

The traditional extended family system used to act as a social protection network that provided security to family members in case of disasters. This extended family system is still seen as functional in rural parts of Sri Lanka, where relatives look after and attend to the needs of the families that are left behind due to climate migration. Current coping strategies also include tank-based irrigation systems that reduce dependence on seasonal rainfall, and traditional land-sharing systems used during droughts to make maximum use of available water.

At the policy level, Sri Lanka has formulated several documents that address some of the underlying factors related to climate vulnerability and the drivers of migration. These include the Nationally Determined Contributions, National Adaptation Plan, National Climate Policy, the National Comprehensive Disaster Management Programme, and the National Agriculture Policy. Farming communities are further protected by government relief and social assistance programmes, a national crop insurance scheme, and a national natural disaster insurance.

However, there are almost no policies that explicitly link climate change and migration. The country has formulated a National Migration Health Policy outlining certain issues, but there are no dedicated policies that link mental health, migration and climate change. And there is little integration of the specific challenges created by slow-onset impacts. Better social protection through policy interventions is needed to protect the migrants, as well as the families left behind.

Households with better access to irrigation and other risk management techniques (for example drought-resistant crop varieties or crop insurance) are more resilient to climate impacts and less susceptible to shocks. However, the exact scale of their impact on mobility patterns and the links between climate change, migration and agriculture in Sri Lanka are not yet fully known.

10 SLYCAN Trust (2020). Working Paper: Climate Change and Human Mobility in Sri Lanka. Impacts and Actions across Sectors.

Loss and damage beyond adaptation

Even households with irrigated cultivation and risk management are faced with unavoidable climate impacts. The shifting weather patterns and agroecological conditions have heightened the risks to agricultural livelihoods and point toward a strong need for integrated risk management and livelihood diversification. Those measures, however, can only alleviate the effects of temperature rise, sea level rise, and erratic precipitation, not avoid them.

Climate-related migration in the study area is widespread. All surveyed households reported L&D related to climate change affecting their livelihoods, with the vast majority naming drought, water scarcity, yield reduction, and pests and diseases as the most pressing problems. In four villages in Trincomalee District surveyed in 2018, 80% of the households had at least one family member migrating, while 84% named drought as the major climate-related impact to their agriculture. Around two thirds of the household members staying behind reported financial problems and a lack of proper income related to yield reduction or failed harvests. This suggests a strong connection between climate change, poverty and migration. There are currently no comprehensive studies exploring these links at a national or provincial level, but the research conducted by SLYCAN Trust suggests that the impacts on social cohesion, health and vulnerable groups are significant.[11]

Support needed in future

Climate-related human mobility can be a form of L&D, when people are forced to leave their homes as a result of climate-induced L&D. Such incidents of migration are expected to become more widespread and prevalent over coming decades, with most migration and displacement taking place internally and in developing countries.

To support migrants, their families and their host communities, there must be enhanced research to build a better evidence base, and integrate this into policies and planning processes. This will enable greater understanding of the connections between human mobility, sectoral actions and cross-cutting issues such as gender, health, informal employment, social protection, education and youth.

There also needs to be better support for migrants, displaced people, their family members and host communities. This includes facilitating safe and successful migration through skill-building, financial support, housing or shelter, social protection, social networks and healthcare for migrants. Finally, there needs to be a greater link between national and international policy discussions, integrating key areas related to human mobility into climate-related processes at all levels.

Lessons learned

It is important to talk to affected people on the ground to capture their voices and perspectives. Building a stronger evidence base on climate-related mobility in Sri Lanka, particularly when it comes to gender-specific data, should be prioritised. This could support further research and policy interventions.

Migrants and their communities also need support. But there is no comprehensive policy framework that jointly addresses climate change and migration, and there are gaps in institutional coordination and information exchange. Migrants are often part of the informal sector and not included in many data collection processes, making it difficult for them to access services, have continuity of healthcare, and manage climate-related risks.

11 Ibid.

SLYCAN Trust works on the national, regional and global level to contribute to the evidence base on climate change and human mobility, build capacities of key actors, and facilitate a better understanding of the challenges and potential solutions in addressing this relationship. By analysing existing gaps and needs, this work aims to further the evidence-based integration of human mobility concerns into policies, plans, processes and actions, as well as share good practices with networks and organisations around the globe.

Synopsis

The impacts of climate change on agricultural communities in Sri Lanka cause direct L&D to livelihoods and compound other risks and vulnerabilities. For vulnerable households, climate change can serve as an underlying driver of human mobility, leading household members to migrate on a seasonal or long-term basis to access additional income and employment options and reduce losses. However, such migration often puts serious strain on social cohesion and can adversely affect individual migrants, as well as their families and communities. Migrating family members are vulnerable to exploitation, unsafe work conditions, injuries, illness and other adverse impacts on their health. While women, children, youth, the elderly, and those with special needs stay behind, they face further adverse climate impacts and additional livelihood burdens.

Living with extremes: loss and adjustment in the face of drought and cyclones in the Cook Islands

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Geography	South Pacific Islands
Location	Cook Islands
Climate hazards	**Slow-onset:** droughts, high tides **Rapid-onset:** cyclones
Vulnerable groups	Those living in remote and coastal regions
Response mechanism	**Anticipatory:** early warning systems, moving goods to higher grounds/inland, securing homes, local knowledge, resource accumulation, community safety procedures **Survival:** adaptation of agricultural practices, resource sharing, water rationing (household and communal), escape road, traditional resource management strategies **Recovery:** kinship and social networks



Context

Although seemingly small with 15 islands covering less than 240km^2, the Cook Islands is a Polynesian island nation spread over a 2 million km^2 exclusive economic zone in the Southern Pacific Ocean (see Figure 1).[1] In 2016, the Cook Islands' population was 17,434 with Rarotonga, the centre of government and commerce, being the most populous island (75%), followed by the Southern group of islands (19%) and Northern group (6%). Some islands and their residents are extremely remote, and efficient transport and communication systems are difficult to develop to cover such a large area.[2] Remoteness also poses logistical issues for post-disaster relief and response efforts[3] and, when combined with the Cook Islands' small market, makes it difficult for the nation to integrate into international markets.[4]

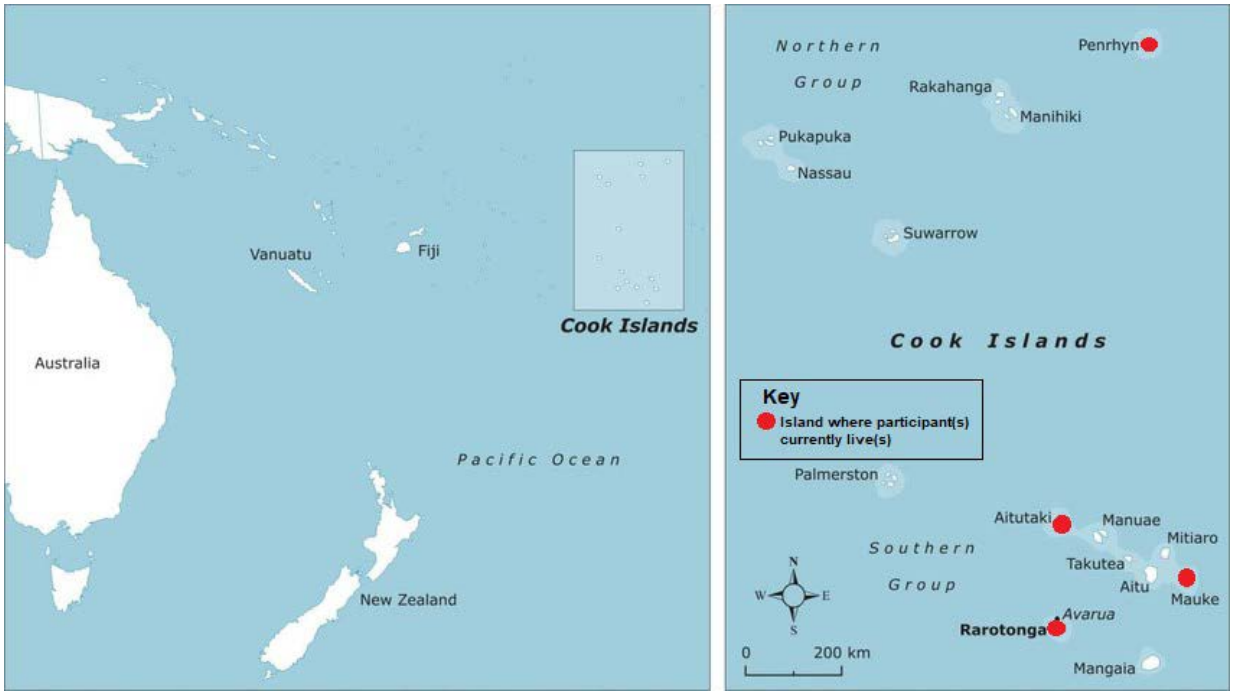


Figure 1: location of the Cook Islands in relation to Australia and New Zealand (left) and the country's islands (right) with indication of where informants for this case study live

Source: Adapted with permission from Blacka, M, Flocard, F and Parakoti, B (2013) Coastal Adaptation Needs for Extreme Events and Climate Change, Avarua, Rarotonga, Cook Islands. Project Stage 1: Scoping and Collation of Existing Data, No. WRL Technical Report 2013/11, Water Research Laboratory, University of NSW, Manly Vale, Australia.

This case study draws on structured interviews conducted in October and November 2020 with 11 Cook Islanders (four women and seven men) who all live in the Southern group of islands, except for one from the Northern rural island of Penrhyn. Participants ranged from 43 to 65 years old (average age 55). Nearly all participants identified with various Christian denominations and were involved to different extents in community activities (eg village and church). Most participants had subsistence livelihoods (dependent on gardens, livestock, poultry and marine resources through fishing), alongside varying income streams including owning a small business, working for the government or an NGO, selling flowers or undertaking

1 GEF, UNDP, SPREP, and Cook Islands Government (2009) Pacific Adaptation to Climate Change. SPREP, Cook Islands. https://www.sprep.org/attachments/67.pdf

2 Cook Islands Statistics Office (2018) Cook Islands Population Census: Census of Population and Dwellings 2016, Cook Islands Statistics Office, Rarotonga, Cook Islands. http://www.mfem.gov.ck/images/documents/Statistics_Docs/5.Census-Surveys/6.Population-and-Dwelling_2016/2016_CENSUS_REPORT-FINAL.pdf

3 World Bank (2015) Country Note: The Cook Islands. World Bank, Washington, DC. http://documents1.worldbank.org/curated/en/405171468244771591/pdf/949800WP0Box380ry0Note0Cook0Islands.pdf

4 UN (2020) The Cook Islands: Demographic, economic and gender profile.

contract work. One participant was retired. All participants gave informed consent to take part with ethics approval from the University of Queensland (approval no. 2020000640).

The Cook Islands has a tropical mild maritime climate. This is characterised by a pronounced wet season from November to April — when two thirds of the annual rain falls — and a dry season from May to October (which tends to be cooler for the Southern group).[5] During El Niño, the Southern Cook Islands experience significant decreases in annual rainfall — sometimes by up to 60% — while the Northern group's annual rainfall increases by more than 200% in some cases; a pattern that reverses during La Niña.[6] The cyclone season is between November and April and, in the 41-year period between 1969 to 2010, there were 47 tropical cyclones that passed within 400km of Rarotonga.[7] Despite there being just over one cyclone per season on average, participants emphasised one season (2004–2005) where local people experienced a record of five cyclones in a matter of weeks.

The climate in the Cook Islands has been changing with time: "Currently we have sea level rises, warming temperatures, cyclones and changes to rainfall" (Participant #3). Annual maximum and minimum temperatures have increased since 1950, with Rarotonga experiencing increases of 0.04°C per decade. In Penrhyn, data analysis of records since 1950 to date shows a clear increase in annual rainfall. The waters of the Cook Islands have also been slowly acidifying since the 18th century and rising by 4mm per year since 1993. Continued increases in temperatures, changing rainfall patterns, more extreme rainfall and less frequent, but more intense tropical cyclones are expected.[8] For the informants, drought was the most prominent risk to livelihoods, followed by cyclones, highlighting the weather extremes experienced by communities.

Impacts

The loss and damage (L&D) from drought and cyclones affect both economic and non-economic resources and aspects of people's lives. Due to the subsistence lifestyles of Cook Islanders, drought impacts water availability and induces food and income insecurity, the latter two being a consequence of deteriorating gardens and the loss of staple crops and livestock. People were "scared of being thirsty" with water tanks becoming "salty and unpotable" (Participant #4). Livestock couldn't be cared for adequately so were either sold or "die[d] due to hunger and thirst" (Participant #7). The quality and taste of valued fruit trees were also changing: "do not have the same flavour" (Participant #10).

Cyclones affect food and income security through the destruction of crops and gardens. For many, this meant replanting their gardens. Those with incomes from fishing and the service industry were also affected. "[F]ishers were out of business for months" due to coral damage, decreasing water quality and fish dying "from stress" (Participant #3). The service industry was affected by decreasing tourism: "The loss of tourists meant lower hours worked, less pay earned" (Participant #6). These financial losses have a "100% lasting effect" (Participant #6).

Participants also highlighted L&D to property and infrastructure from cyclones. School buildings, community 'meeting houses' and a hospital were destroyed, sea walls were damaged from high tides, and homes were inundated or completely/partially destroyed. For several families, inundation of homes in

5 GEF, UNDP, SPREP, and Cook Islands Government (2009) ibid; Cook Islands Meterological Service, Australian Bureau of Meterology, and Commonwealth Scientific and Industrial Research Organisation (CSIRO) (2011) Current and Future Climate of the Cook Islands. Pacific Climate Change Science Program Partners. https://www.pacificclimatechangescience.org/wp-content/uploads/2013/06/9_PCCSP_Cook_Islands_8pp.pdf

6 GEF, UNDP, SPREP, and Cook Islands Government (2009), ibid.

7 Cook Islands Meterological Service, Australian Bureau of Meterology, and Commonwealth Scientific and Industrial Research Organisation (CSIRO) (2011), ibid.

8 Cook Islands Meterological Service, Australian Bureau of Meterology, and Commonwealth Scientific and Industrial Research Organisation (CSIRO) (2011), ibid.

past cyclones has resulted in them being internally displaced and temporarily living in tents and school buildings (Participants #4 and #9). The loss of water and power for weeks was also "an inconvenience at the time and played a huge impact on our family", as did the restricted mobility caused by blocked roads (Participant #6). Some roads were also eroded by heavy rain and flooding.

Drought and cyclones also have an impact on emotional wellbeing. During drought, feelings of worry, sadness, anger and tiredness emerged, the latter symbolising the chronic nature of the disaster with prolonged hardships. One participant explained: "It was hard not to bring the right food to your family, [which is] nerve wrecking and stressful … sometimes you turn your anger to your family, which is not fair" (Participant #5). Cyclones evoked sentiments of fear and stress, reflecting the sudden and devastating nature of the disaster: "The worry that the rest of the roof was going to come off, the wind was so loud and we were in complete darkness without power, it was scary" (Participant #6). Repeated disasters, such as drought, followed by a cyclone and then another drought or repeated cyclones, also heighten chronic mental health impacts: " … one cyclone after the other, was extremely stressful" and "makes the struggle harder" (Participants #10 and #5).

Impacts from cyclones and high tides on local landscapes and flora also emerged: " … the flora on the island took months to be repaired due to the sea salt spray, the island looked very desolate at the time, no green grass and the trees were bare of leaves" (Participant #6). Coastal areas were heavily damaged by both the tides and the wind, and were also changing, with one participant explaining how the beaches had disappeared.

Compounding risks/impacts created

Cyclones are exacerbating existing concerns around ciguatera toxins in fish. Degraded local marine ecosystems (ie damaged coral) and water quality are "making even better conditions for troubles like ciguatera" as "damaged, denuded reef[s] will provide suitable habitat" for the algae producing the toxins (Participant #3). This can have a knock-on effect on health, livelihoods and incomes, while also affecting local marine culture: "we will be in terrible trouble economically" (Participant #3).

Another risk relates to out-migration and the loss of traditional ways of life. Many people have migrated away from their homelands, whether within the Cook Islands or "for the greener fields of NZ and Aussie" because of compounded climate change risks and other medical, economic and environmental reasons (Participant #1). Some participants are concerned about the associated "loss to our workforce, our economy" (Participant #6), while others are "more worried about our people leaving our Ipukarea (country)" as there's "no one to care for the land" (Participant #5).

Vulnerabilities/impacts by compounding risks

Climate change and out-migration also interact with other risks, such as development pressures (eg Westernised ways of living) and capitalism, to compound the likelihood of loss to traditional ways of life.[9] Participants shared sentiments around how there's "too much outside influence" and how "the young of today do not respect the elders as we used to" or "are not interested in contributing to the community" (Participants #5 and #6). Traditional subsistence lifestyles are also changing as "Nowadays everyone ha[s] money to buy what they want and need" (Participant #5). This shift away from traditional teachings and ways of life is concerning because "Our elders have the wisdom of yesterday and the future. We must get that from them to guide our future" (Participant #5). This is further exacerbated by losses to traditional knowledge from the changing climate.

9 Campbell, J (2006), Traditional Disaster Reduction in Pacific Island Communities, GNS Science Report 2006/38, p. 46. Institute of Geological and Nuclear Sciences Tech, New Zealand.

Experiences of loss, difficulty and distress during disasters are also rarely equal. Inter and intra-island disparities exist, with participants highlighting the particularly high vulnerability of those who live more remotely or along coastlines, as well as those who may not be as well connected to local leaders.

In terms of remoteness, participants highlighted how, during the five consecutive cyclones in 2004–2005, "[t]he worst affected [were] the people of Pukapuka/Nassau being so far away and isolated" (Participant #10), which affected the effectiveness of prompt relief and aid efforts. Similarly, on Mauke, drought was highlighted as particularly difficult for those living more remotely "because the villages inland are all on a water mains connected to huge aquifer" (Participant #3). Many participants also expressed concerns for those living on coastlines, with houses on the coastline in Mauke identified as vulnerable to larger waves during cyclones (Participants #5 and #4). Households with specific connections to island leaders were also sometimes better warned: "Our island leaders did not wake up every household, they just woke those they want to and left others, which I thought was unfair" (Participant #5).

Climate change risks and recovery processes can also interact with local gendered norms to create unequal workloads and specific gendered impacts on everyday life. Lack of access to water and power after cyclones, for example, added time burdens to women's workloads. Women highlighted how they "had to travel … some distance to collect water in containers and bring back to our home for drinking and cooking" or "go to families on low-lying areas for bathing, washing the clothes" (Participants #3 and #4). Power shortages also added to workloads by forcing one woman to cook an entire freezer's worth of food over a couple of days which, ordinarily "would have lasted us up to a month" (Participant #3).

Adaptation measures

Early warning systems (particularly radio) are proving critical so participants can "listen to the weather report and plot the cyclone's movements" and "stay alert and [be] kept safe" (Participants #10 and #3). Local knowledge and bioclimatic indicators also enabled people to anticipate risk, prepare and reduce potential losses.[10] For example, "the people know when there will be big waves by [observing] which direction the wind is coming from … " (Participant #4).

Being prepared was vital for reducing potential losses from cyclones. When early warnings are given, "immediately the roof [is] tied down" to protect the homes (Participant #6).[11] Accumulating critical resources prior to the cyclone season was also important.[12] This includes stocking up on "batteries for the radio", "water … torches, lantern … a generator", "essential foodstuffs" and "bottled and dried foodstuffs and a heap of coconuts" (Participants #10, #6, #10, #3). It's also important to harvest, preserve and freeze as many crops as possible.

For those living along the coastlines concerned about storm surges during cyclones, many were moving livestock and precious items to families on higher grounds and in inland villages prior to cyclones. This illustrates the importance of intra-island networks in reducing the risk of losses.[13] Once the danger passed, they bring them back (Participants #4 and #10).

At the community level, several adaptation and recovery activities were implemented, including the building of a "new escape road … to the inland villages should big waves hit" (Participant #4) and the identification

10 McMillen, H, Ticktin, T, Friedlander, A, Jupiter, S, Thaman, R, Campbell, J, Veitayaki, J, Giambelluca, T, Nihmei, S, Rupeni, E, Apis-Overhoff, L, Aalbersberg, W, Orcherton, DF (2014) Small islands, valuable insights: Systems of customary resource use and resilience to climate change in the Pacific. Ecology and Society, Vol. 19, p. 44.; Granderson, A (2017) The Role of Traditional Knowledge in Building Adaptive Capacity for Climate Change: Perspectives from Vanuatu, Weather, Climate, and Society, Vol. 9. https://doi.org/10.1175/WCAS-D-16-0094.1; de Scally, D (2019) Because Your Environment Is Looking after You: The Role of Local Knowledge in Climate Change Adaptation in the Cook Islands, University of Waterloo, Waterloo, Ontario. https://uwspace.uwaterloo.ca/handle/10012/14399

11 de Scally, D, op cit.

12 de Scally, D, op cit.

13 Granderson, A, op cit.

of clear community "safety procedures to prepare us all" (Participant #10). One participant also highlighted that "[o]ur country have a system in place, the government have the Emergency Management Cook Islands, then the Red Cross and Island Governments for each island where each party knows their responsibilities" (Participant #4).

As prolonged and more insidious events, droughts can be harder to prepare for. But participants indicated that, to cope, households "conserve the water [and] cutout the wastage" by purchasing water tanks and rationing household water use (Participant #2). Those from outer islands also discussed restricting community water storage and the importance of water deliveries from Rarotonga, highlighting the important collective action and cooperation required.[14] Participants also used local knowledge and observations of local environmental conditions and processes to adapt their agricultural practices to drier conditions.[15] For some, this involved focusing on local crops such as native cabbage, tomatoes, beans and capsicums, that have adapted to drier and saltier conditions. For others, adaptation involved planting in specific areas/soils that remain cooler during drier periods: "Plant the makatea (coral/stoney) land during drought season … and also plant in the lowest area of the swamp" (Participant #5).

Several participants highlighted the importance of traditional knowledge (see Figure 2) and resource management strategies for dealing with resource variability (eg the ra'ui traditional system for conservation and preservation of resources). Although religious narratives and biblical scriptures were sometimes associated with complacency and a lack of proactiveness, they are also being used by some as a critical springboard for action, encouraging disaster preparedness and environmental stewardship: "Creation Care: learning to live in harmony with nature rather than fight it has been valuable for developing resilience … taking Jesus' example" (Participant #3).



Figure 2: traditional fish trap in Manihiki
Credit: Poroa Arokapiti

Kinship and social networks also proved critical for recovery, particularly through processes of resource sharing and assistance, buffering disturbance and loss, and speeding up recovery.[16] "The best way to cope is for the communities to come together, work together" (Participant #5). During a drought in Mauke in 1999, for example, inter- and intra-island networks allowed for sacks of coconuts and taro to be sent from unaffected to affected islands, which were then preserved to manage resource variability. Participants also highlighted how, for those whose land became too dry, they could use and share their families' land to grow staple crops. For some, these kinship networks expanded internationally, with one participant having a relative in New Zealand who sent timber and iron roofing for rebuilding a damaged house.

Loss and damage beyond adaptation

Participants shared that there is a certain level of L&D that they accept will occur regardless of adaptation and preparation strategies, especially in the face of cyclones: "It most likely is an issue that we cannot avoid or deal with but it is always good to think ahead and be prepared before it happen" (Participant #8).

14 Granderson, A, op cit.

15 de Scally, D, op cit.

16 Campbell, J (2009) Islandness: Vulnerability and Resilience in Oceania. *Shima: The International Journal of Research into Island Cultures*, Vol. 3, pp. 85–97.

In the face of losses that are 'expected' and 'accepted', many participants reflected a sense of stoicism and determination to carry on: "Just clean the rubbish, fix the broken parts and life goes on"; "accept the situation and just move on" (Participants #6 and #3).

Nearly all participants also discussed mobility in the extreme weather context. For some "the shift for moving inland was finally instigated" (Participant #4), while others have made the move to Rarotonga or onwards to New Zealand and Australia. Those remaining on ancestral homelands are wondering whether they themselves or their descendants will have to move to reduce risk as other adaptation methods become insufficient. For one village on Mauke, there has been "meetings held about moving the people" and "new land [identified] for the meeting house" (Participant #4). For many, migration is often the last resort.

This type of movement may be considered as an adaptation approach, but it is also a loss for Cook Islanders who have deep connections to land and sea: "Consider 'te Pito Enua' (the umbilical cord between us and the land); people and environment being so interconnected that to sever one is to sever the other" (Participant #3). Land, place and people (past and present) are intricately interwoven, and disconnection can have devastating consequences for identity, wellbeing and material, social and cultural security.[17] Migration can also have knock-on effects on livelihoods, "our workforce, our economy" and emotional health (for those who have migrated but also for those who remain): " … you just feel helpless and think about what the hell for, what if now no one is coming back. You miss your family those far away" (Participants #6 and #1).

There are also some losses to traditional knowledge, particularly around biocultural indicators or seasons that help anticipate risk: "Growing up, the teaching was that the cyclone period is January to March, but nowadays, it is as if a cyclone can just happen anytime" (Participant #4). In terms of agricultural practices, another participant shared that "[t]here is also a change of seasons, as we normally know the months for each type of fruit to come out. Now it is as if the unpredictable is always happening" (Participant #7). This kind of perceived unpredictability is difficult to adapt to and may contribute to skepticism around the relevance of Indigenous knowledge into the future.[18]

Support needed in future

Participants asserted that there is a strong drive to remain on homelands and be self-sufficient (Participant #3), and that the "[r]unning of these disasters should be kept on island rather than from outside. People of the islands should be trained" (Participant #2). This indicates the kind of support that local people want from external government, donors and organisations. Too often, strategies have been imposed on Pacific communities. Instead, external actors must act as 'facilitators' of desired adaptation aspirations for local people. This involves resourcing and equipping locals with any additional skills, resources and knowledge that enable them to pursue the adaptation outcomes they value and support them to achieve local objectives equitably and effectively.[19] Communities should be empowered and their critical coping strategies, diverse capacities and Indigenous knowledge should be supported.[20]

17 Campbell, J (2019) Climate Change, Migration and Land in Oceania. Policy Brief No.37. Toda Peace Institute, Tokyo. https://toda.org/assets/files/resources/policy-briefs/t-pb-37_john-campbell_climate-change-migration-and-land-in-oceania.pdf

18 de Scally, D, op cit.

19 McNamara KE, Clissold R, Westoby R, Piggott-McKellar AE, Kumar R, Clarke T, Namoumou F, Areki F, Joseph E, Warrick O and Nunn PD (2020) An assessment of community-based adaptation initiatives in the Pacific Islands. Nature Climate Change 10(7) 628-639. https://doi.org/10.1038/s41558-020-0813-1

20 Westoby, R, McNamara, KE, Kumar, R and Nunn PD (2020) From community-based to locally led adaptation: Evidence from Vanuatu. Ambio, 49(9) 1466-1473. https://doi.org/10.1007/s13280-019-01294-8

Lessons learned

Context-specific strategies and responses for managing climate hazards and resource availability should be built upon and learned from.[21] These kinds of place-based, high-resolution observations and adaptations must be recorded, monitored and shared. They can then help guide culturally and contextually appropriate resource management and adaptation measures.[22]

Participants also highlighted the need to integrate traditional knowledge with 'new' knowledge: " … we just need for our people to stay firm and work the land, by also following the advises of our Ui Tupuna [literal translation of 'ask the ancestor'] and that of the world educated. Combine the two together to get the best results" (Participant #5). This illustrates an understanding that different knowledge and worldviews (ie scientific or local knowledge) are not irreconcilable or competing, but that they can work in tandem.[23] Similarly, some participants demonstrated how religious narratives and biblical scriptures — which have often been viewed as problematic — can actually be used as a critical resource for climate change communication and advocacy. This would encourage disaster preparedness and environmental stewardship through non-economic and non-scientific motives that may better resonate with the local context.[24]

Synopsis

This case study explores how communities in the Cook Islands are experiencing, preparing for, responding to and recovering from droughts and cyclones. We found that the immediate devastation of cyclones and the chronic devastation of droughts have various impacts, most of which take an emotional toll and affect abilities to meet household needs. Experiences of disasters over centuries have led to the development of significant local knowledge and traditional coping strategies which enable anticipation, preparation and adaptation to extreme weather. Looking ahead, Cook Islanders' tacit knowledge and endogenous spiritual and community resources offer agency, hope and resilience in the face of climate change into the future.

21 McMillen, H, Ticktin, T, Friedlander, A, Jupiter, S, Thaman, R, Campbell, J, Veitayaki, J, Giambelluca, T, Nihmei, S, Rupeni, E, Apis-Overhoff, L, Aalbersberg, W, Orcherton, DF ibid; Granderson, op cit.

22 Ibid.

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Disaster and degradation: the impact of Tropical Cyclone Harold on Western Santo Island, Republic of Vanuatu

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Geography	Small Island Developing State; South Pacific
Location	Western Santo Island, Vanuatu
Climate hazards	**Slow-onset:** droughts, sea level rise, extreme rainfall, ocean acidification **Rapid-onset:** tropical cyclones, landslides, forest fires
Vulnerable groups	Women and girls
Response mechanism	**Anticipatory:** green infrastructure, less development, climate-smart agriculture **Survival:** Wi-Fi stations

Context

The Republic of Vanuatu, located in the South Pacific, has a population of around 300,000[1] with many living in small coastal villages spread across 80 islands. Vanuatu has a highly circular economy, relying on secondary or renewable materials and energy sources for 59% of the materials used for domestic consumption.[2]

General Area	Village/Station	Pop	HH	%
Kerevinopu	**Kerevinopou**	82	15	3.2
	TovoTovo	91	21	3.5
	Lalaola	110	24	4.2
Kerewai 1	**Sulimauri**	60	14	2.3
	Sakele	28	6	1.1
	Tialona	36	9	1.4
	Toromauri	74	18	2.9
	Pelopvu	63	14	2.4
Kerewai 2	**Jananavusvus**	125	21	4.8
	Tanakovo	190	36	7.3
	Voji	74	17	2.9
	Valapei	169	36	6.5
	Pesale	11	3	0.4
	Pataiolmatap	15	4	0.6
	Navai	27	4	1.0
	Patuie	19	3	0.7
Pareo	**Pareo**	125	19	4.8
	Salalope/Lovuha	110	20	4.2
Sauriki	**Sauriki**	376	90	14.5
Linduri	**Linduri**	80	17	3.1
Wusi	**Wusi**	145	28	5.6
Kerepua	**Kerepua**	135	21	5.2
Elia	**Elia**	209	34	8.1
Tasmate	**Tasmate**	152	36	5.9
Vasalea	**Vasalea**	86	18	3.3
		2592	**528**	**100.0**

Figure 1: villages of Western Santo, Vanuatu including population size, number of households and percentage of overall residents

Note: due to rounding, numbers presented may not add up precisely to the totals provided and percentages may not precisely reflect the absolute figures

Despite making a negligible contribution to global greenhouse gas emissions (0.0016%),[3] Vanuatu experiences high levels of climate-induced vulnerabilities, ranging from tropical cyclones to prolonged droughts, ocean acidification, sea level rise and extreme rainfall events.

Despite this, the country has submitted one of the most ambitious Nationally Determined Contributions (NDC) in the world, committing to achieving 100% renewable energy in the electricity generation sector by 2030.

The western side of Espiritu Santo Island is remote and inaccessible, with no roads, wharves or electricity grids, and minimal mobile phone network coverage. The people of Western Santo live a subsistence lifestyle under traditional governance systems, growing indigenous crops, and using traditional canoes for hook and line fishing. The total population of the area is 2,592, spread across 25 villages and residential stations, some several hours' hike into the mountains (see Figure 1).

Situated on the rain-shadow side of the Santo Mountain Chain (the highest in the country), the area is prone to extreme droughts, characterised by landslides, forest fires, and the drying up of rivers and streams. The latter results in food and water insecurity, and has severe health implications. Due to the extreme conditions, the area is rich in biodiversity, and has been designated a Key Biodiversity Area within the Eastern Melanesian Biodiversity Hotspot,[4] home to bird and mammal species found nowhere else in the world.

1 https://vnso.gov.vu/index.php/en/statistics-report/census-report/national-population-and-housing-census/province

2 UNDP (2021) Circular economy opportunities: Vanuatu. https://www.ndcs.undp.org/content/ndc-support-programme/en/home/impact-and-learning/library/vanuatu-circular-economy-opportunities.html

3 UNDP (9 April 2019) Integrated Data Tracking for Vanuatu's Climate and Development Targets. https://www.ndcs.undp.org/content/ndc-support-programme/en/home/impact-and-learning/ideas-and-insights/20190/how-integrated-data-tracking-will-help-vanuatu-achieve-its-clima.html

4 https://www.cepf.net/our-work/biodiversity-hotspots/east-melanesian-islands

Impacts

On 6 April 2020, Category 5 Tropical Cyclone Harold devastated Northern Vanuatu with sustained winds of up to 215km/h, making it the second strongest cyclone ever recorded in the nation.[5] With no access to mobile phones or internet, many families were caught unaware. Sheltering in bamboo huts with thatched rooves, there was no safe place to hide. According to the Government's Post Disaster Needs Assessment,[6] cyclone Harold resulted in more than US$500 million in loss and damage (L&D). Development aid provided to Vanuatu for response and recovery has been less than US$100 million.

In May 2020, the Santo Sunset Environment Network (SSEN) (a local indigenous NGO)[7] undertook a biodiversity assessment mission at the request of the Department of Environmental Protection and Conservation.

The assessment team observed devastating environmental effects from Cyclone Harold, including the death of flora and fauna, destruction of forest habitat, damage to coral reefs, siltation of rivers, erosion of low-lying areas and beaches, and extensive landslides and landslips.

Assessors also observed how the cyclone forced people to use environmental resources more intensively. This included hunting wild birds and flying foxes, increased fishing, high pressure on building materials like palm leaves, and deforestation pressure to plant new crops, bamboo and bush ropes. Domestic and feral livestock like bullock and pigs were forced to scavenge throughout the entire community areas, causing damage to the environment and wildlife.

Almost all households rely on the forest to source building materials, particularly for repairing damage caused by Cyclone Harold. This reliance is leading towards unsustainable harvesting, with a massive shortage of roof thatching from palms to rebuild more than 730 structures that were fully destroyed or badly damaged by the cyclone.

The cyclone damage to forests also allowed invasive species to expand, such as the big-leap rope (Merramia), mile-a minute vine, wild peanut, lantana, the Indian myna bird, rats, feral cats and wild pigs.

Compounding risks/impacts created

Due to low accessibility, infrastructure development in Western Santo is minimal and economic activity limited to primary production, heavily dependent on a healthy environment. When a climate event affects habitat and environmental services, L&D experienced by those Indigenous communities increases.[8]

Food crops primarily include water taro, dryland taro, banana, yam, and manioc, interspersed with vegetables like island cabbage, corn, tomatoes, and cucumber. None of these crops can withstand the impacts of a Category 5 cyclone, and even the best pre-disaster preparation or adaptation cannot withstand this level of destruction. Similarly, forests and biodiversity were overwhelmed by the intensity of the storm, and natural resilience was limited. Housing, despite the use of traditional time-tested storm-withstanding construction designs, was demolished in minutes.

5 https://www.severe-weather.eu/tropical-weather/harold-becomes-2nd-strongest-cyclone-vanuatu-mk/

6 Government of Vanuatu (2020) Post-Disaster Needs Assessment: TC Harold & COVID-19, Vanuatu (draft). https://www.shelltercluster.org/sites/default/files/docs/draft_volume_a_tc_harold_and_covid-19_pdna_summary_report_compressed.pdf

7 Santo Sunset Environment Network. www.SantoSunset.org

8 McNamara, KE, Westoby, R and Chandra, A (2021) Exploring climate-driven non-economic loss and damage in the Pacific Islands. *Current Opinion in Environmental Sustainability*, Volume 50, 2021, pp 1–11,ISSN 1877-3435. https://doi.org/10.1016/j.cosust.2020.07.004 (https://www.sciencedirect.com/science/article/pii/S1877343520300531)

Few NGOs or government departments work in West Coast Santo due to the logistical challenges, so communities are not receiving the expected climate resilience or L&D support.

In general, West Coast Santo women and girls are more vulnerable due to lower levels of education, limited access to resources and economic options, differences in mobility, and entrenched patriarchal discrimination. Compounding these factors is the dependence of many West Coast women on natural resources for their livelihoods. Women on the West Coast tend to do most of the agricultural work, gather fuelwood and fetch water for their families. The destruction of the forest habitat by Cyclone Harold has increased the workload for women and girls as they now must walk longer distances to access clean water and fetch fuelwood.

Vulnerabilities/impacts by compounding risks

There are multiple clear links between severe Category 5 Cyclone Harold, environment L&D and new vulnerabilities.

1. **Disasters have environmental and economic effects, which in turn affect people**

   The people of the West Coast are now facing a severe humanitarian crisis, not only due to the direct impacts of the high winds on homes and people, but also the extensive damage to the natural environment. This typically provides a high percentage of people's daily food intake, water supply, building materials, medicines and income generation.

2. **Environmental degradation increases disaster risk**

   As many habitats have been damaged by Cyclone Harold, the people of the West Coast are facing increased risk of additional disaster impacts. For example, with all local gravity-fed water systems damaged, local incidences of water-borne illness are increasing. With the onset of the dry season and drought there is chronic food shortage.

3. **Disasters disrupt access to environmental goods and services**

   Cyclone Harold has caused extensive damage to forests on the West Coast. Most bush tracks are now inaccessible due to fallen trees and vegetation. This physical barrier prevents villagers from hunting and accessing urgently needed bush materials like ropes and medicines. It also means there is additional harvesting pressure on resources closest to the village, and in the sea. At the individual level, women and children are forced to spend more time roving and collecting to meet household subsistence needs, and insufficient time on study or social activities.

4. **Disasters increase strain on traditional governance**

   With almost all individuals and families focused on the basic needs of food, water and shelter, traditional and local systems of resource governance are weakened. Committees that typically manage and care for environmental resources are, for the most part, not functional, and chiefs find it difficult to play a role in resource restriction when people are facing food shortage. Many traditional restrictions have been ignored, and environmental rules set locally have been relaxed, undermining the centuries-old environmental governance systems of local chiefs. At the individual household level, parents are no longer able to demonstrate tribal restrictions on certain totems as there is a more pressing need for food than cultural maintenance.

Adaptation measures

While Severe Category 5 Cyclone Harold has caused severe hardship and extensive L&D for the people of West Coast Santo, villagers and chiefs — in partnership with the SSEN — have demonstrated their resolve to take all opportunities to commence adaptation programmes.

- The reconstruction of homes and other structures like schools, clinics and churches are now incorporating environmental and climate risks, to reduce vulnerabilities and increase future resilience. For example, elder architects familiar with long-forgotten traditional building techniques are now sought out to advise on home construction. Families are rethinking the locations of their homes, with many moving to safer sites. Green building materials, such as strong weaves of coconut thatch, are being promoted by the SSEN.
- Development as usual, without a climate and disaster risk consideration, is no longer acceptable. The SSEN is currently engaged in a major campaign to prevent logging associated with a proposed road development, arguing that intact forests will enable long-term sustainable development, and essential pre- and post-disaster environmental services, versus short-term infrastructure gains. The SSEN has also held two Environment Camps focused on understanding environmental services by future generations.
- Due to the major food insecurity vulnerabilities, the SSEN is working in partnership with local government to implement climate-smart agriculture programmes, which also support the implementation of Vanuatu's NDC goals on agriculture. These regenerative agriculture approaches minimise harm to the environment and expand forest capacity to provide ecosystem services and resilience. Dozens of training courses and new agriculture plots have been installed in villages and schools with improved agriculture techniques such as mulching and composting, ally cropping with trees, drip irrigation, and the use of drought resistant crops.
- To support access to information on adaptation and risk management, the SSEN has now installed five solar-powered satellite internet community Wi-Fi stations in some of the most remote communities, as well as solar lighting systems in other communities. This work directly supports Vanuatu's goal of generating 100% renewable energy by 2030, with the added benefit of enabling access to telecommunications for future early storm warnings.

Channelling financial support through indigenous NGOs and civil society groups like the SSEN is an essential approach that should be replicated and scaled up across the nation. Local people and local institutions are often best placed to respond with contextualised and appropriate solutions.

Loss and damage beyond adaptation

Despite the best efforts of Western Santo's people to adapt, there is a major shortfall in what can be achieved, and the worst impacts of climate change resulting in L&D. Cyclone Harold demonstrated that even after the most careful planning and village adaptation investment, very little can withstand the ravages of a direct hit by a Category 5 storm. Particularly devastating was the L&D to the forest habitat, which provided short- and long-term resilience to Indigenous communities on Western Santo.

Of the total Forest Area in West Coast Santo area council (692km^2), 102.8km^2 was fully destroyed, while 109.9km^2 was damaged (can recover over time). Using globally accepted forest valuation methodologies,[9] and assuming a conservative estimated economic loss of ten million vatu per km^2 of forest lost, and five million vatu per km^2 of forest damaged, we calculated that Cyclone Harold caused an economic L&D to forest ecosystem services of 1.6 billion Vatu (US$14.2 million) (as detailed in Figure 2).

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	Pop	Total Village Land + Sea km²	Land Area km²	Sea Area km²	Population Density per km²	Forest Area km²	Grasslands km²	Gardens km²	Village km²	Forest Loss km²	Forest Loss Value VT (VUV)	Forest Damage km²	Forest Damage Value VT (VUV)	Forest Intact km²
Kerevinopu	82	27.6	20.3	7.3	4.0	14.2	10.2	2.0	1.0	2.8	28,462,000	4.3	21,346,500	7.1
TovoTovo	91	20.7	15.0	5.7	6.1	10.5	7.5	1.5	0.7	2.8	28,462,000	4.3	21,346,500	3.4
Lalaola	110	18.4	14.5	3.9	7.6	10.2	7.3	1.5	0.7	4.1	40,600,000	4.1	20,300,000	2.0
Kerewai 1	261	25.2	19.1	6.1	13.7	13.3	9.5	1.9	1.0	6.7	66,745,000	6.7	33,372,500	0.0
Kerewai 2	630	31.1	27.6	3.4	22.8	19.3	13.8	2.8	1.4	9.7	96,740,000	9.7	48,370,000	0.0
Pareo/Salalope	235	68.1	54.2	13.9	4.3	37.9	27.1	5.4	2.7	19.0	189,595,000	19.0	94,797,500	0.0
Sauriki	376	68.2	56.5	11.7	6.7	39.6	28.3	5.7	2.8	19.8	197,820,000	19.8	98,910,000	0.0
Linduri	80	50.5	40.3	10.2	2.0	28.2	20.1	4.0	2.0	11.3	112,756,000	11.3	56,378,000	5.6
Wusi	145	49.8	38.9	10.9	3.7	27.2	19.4	3.9	1.9	10.9	108,836,000	10.9	54,418,000	5.4
Kerepua	135	76.9	60.8	16.1	2.2	42.6	30.4	6.1	3.0	8.5	85,148,000	12.8	63,861,000	21.3
Elia	209	80.8	63.4	17.3	3.3	44.4	31.7	6.3	3.2	2.2	22,200,500	2.2	11,100,250	40.0
Tasmate	152	95.9	79.2	16.6	1.9	55.5	39.6	7.9	4.0	2.8	27,734,000	2.8	13,867,000	49.9
Vasalea	86	79.0	64.1	14.8	1.3	44.9	32.1	6.4	3.2	2.2	22,449,000	2.2	11,224,500	40.4
	2592	**692.0**	**554.0**	**138.0**	**79.7**	**387.8**	**277.0**	**55.4**	**27.7**	**102.8**	**1,027,547,500**	**109.9**	**549,291,750**	**175.2**

Figure 2: estimated economic loss and damage to forest ecosystem services caused by Cyclone Harold

Note: due to rounding, numbers presented may not add up precisely to the totals provided and percentages may not precisely reflect the absolute figures

Figures 3 and 4, below, highlight the number of plants destroyed and damaged in each of the areas of West Coast Santo. The data was sourced from primary assessments undertaken by newly established village Community Disaster and Climate Change Committees.

	Coconut Trees	Natangura Trees	Kava Plants	Taro Plants	Sandalwood Trees	Yam Plants	Orange Trees
Kerevinopu	73	206	1000	400	58	167	8
TovoTovo	81	228	335	222	64	185	9
Lalaola	187	530	778	516	149	430	21
Kerewai 1	648	1834	2693	1784	517	1489	74
Kerewai 2	1564	4427	7392	4307	1247	3594	178
Pareo/Salalope	583	1652	1654	1607	620	1341	66
Sauriki	934	2642	2567	2571	498	2146	106
Linduri	136	385	566	375	109	313	16
Wusi	247	699	1026	680	197	567	28
Kerepua	120	339	497	330	95	275	14
Elia	67	189	277	184	53	153	8
Tasmate	49	137	202	134	39	111	6
Vasalea	27	78	114	76	22	63	3

Figure 3: plants destroyed (total loss)

	Coconut Trees	Natangura Trees	Kava Plants	Taro Plants	Sandalwood Trees	Yam Plants	Orange Trees
Kerevinopu	73	206	1000	400	58	167	8
TovoTovo	81	228	335	222	64	185	9
Lalaola	125	353	519	344	100	287	14
Kerewai 1	278	786	1154	765	221	638	32
Kerewai 2	670	1897	3168	1846	534	1540	76
Pareo/Salalope	250	708	709	689	266	575	28
Sauriki	400	1132	1100	1102	213	920	46
Linduri	91	257	377	250	72	209	10
Wusi	165	466	684	453	131	378	19
Kerepua	120	339	497	330	95	275	14
Elia	156	441	647	429	124	358	18
Tasmate	113	320	470	312	90	260	13
Vasalea	64	181	266	176	51	147	7

Figure 4: plants damaged (partial loss, will recover after a period)

Cyclone Harold caused an economic L&D to economically valuable crops worth 2.6 billion Vatu (US$5.3 million).

In addition to garden crops, all water systems in the West Coast area council were damaged by Cyclone Harold. Water represents an essential ecosystem service stemming from the environment. Similarly, ecosystem products originating from the forest and other areas are used to construct homes and structures on the West Coast. These materials include bush rope, timber, posts and forest-based tools like digging sticks and cooking utensils. Cyclone Harold caused an economic L&D to environmental materials for homes and water supply ecosystem services of 321 million Vatu (US$2.8 million).

Overall L&D from Cyclone Harold on environmental services and products in West Coast Santo was 4.5 billion vatu (US$39.9 million), as detailed in Figure 5.

	Forest Services	Trees	Crops	Water Supply	Structures	TOTAL
Kerevinopu	VUV 49,808,500	VUV 44,726,158	VUV 7,740,357	VUV 8,118,000	VUV 2,050,000	**VUV 112,443,015**
TovoTovo	VUV 49,808,500	VUV 49,635,126	VUV 2,731,825	VUV 9,009,000	VUV 2,450,000	**VUV 113,634,451**
Lalaola	VUV 60,900,000	VUV 103,060,525	VUV 5,635,765	VUV 10,890,000	VUV 3,750,000	**VUV 184,236,290**
Kerewai 1	VUV 100,117,500	VUV 326,616,124	VUV 17,759,865	VUV 25,839,000	VUV 13,650,000	**VUV 483,982,489**
Kerewai 2	VUV 145,110,000	VUV 788,383,747	VUV 48,282,881	VUV 62,370,000	VUV 16,400,000	**VUV 1,060,546,628**
Pareo/Salalope	VUV 284,392,500	VUV 350,348,590	VUV 11,312,109	VUV 23,265,000	VUV 7,900,000	**VUV 677,218,199**
Sauriki	VUV 296,730,000	VUV 380,758,491	VUV 17,616,137	VUV 37,224,000	VUV 10,500,000	**VUV 742,828,628**
Linduri	VUV 169,134,000	VUV 74,953,109	VUV 4,098,738	VUV 7,920,000	VUV 1,300,000	**VUV 257,405,847**
Wusi	VUV 163,254,000	VUV 135,852,511	VUV 7,428,963	VUV 14,355,000	VUV 3,000,000	**VUV 323,890,474**
Kerepua	VUV 149,009,000	VUV 73,634,528	VUV 4,052,708	VUV 13,365,000	VUV 1,750,000	**VUV 241,811,236**
Elia	VUV 33,300,750	VUV 58,333,636	VUV 3,262,580	VUV 20,691,000	VUV 2,450,000	**VUV 118,037,966**
Tasmate	VUV 41,601,000	VUV 42,424,462	VUV 2,372,785	VUV 15,048,000	VUV 1,100,000	**VUV 102,546,247**
Vasalea	VUV 33,673,500	VUV 24,003,314	VUV 1,342,497	VUV 8,514,000	VUV 850,000	**VUV 68,383,311**
	VUV 1,576,839,250	**VUV 2,452,730,321**	**VUV 133,637,210**	**VUV 256,608,000**	**VUV 67,150,000**	**VUV 4,486,964,781**

Figure 5: overall L&D from Cyclone Harold on environmental services and products in West Coast Santo

Note: due to rounding, numbers presented may not add up precisely to the totals provided and percentages may not precisely reflect the absolute figures

Once these environmental services are damaged beyond recovery, or worse, ecological tipping points are exceeded, there will be little opportunity for further adaptation, resulting in forced migration and displacement.

Support needed in future

Financial support is urgently required for households and families on Western Santo to recover. More than 17 months after the storm and with nearly 90% of structures destroyed, no shelter support (other than tarps) has been provided by government or humanitarian partners. Additionally, water systems in every community were destroyed, and NGOs have only provided support for three out of 25 villages and residential stations. Safe drinking water remains a major challenge.

More than financial support, the work of indigenous civil society groups like the SSEN must be expanded. International NGOs should, wherever possible, partner with those working at the grassroots level. There have been instances where larger NGOs have gone to Western Santo without informing or consulting local leaders and civil society. This has resulted in incomplete and inadequate support, particularly as the 'fly-in, fly-out' partners (even if they are based in the capital city) do not know the local context, people or situations in Western Santo.

Technology is still a major gap. Having a mobile phone and internet connectivity can be lifesaving. Since the cyclone, the SSEN has established satellite internet Wi-Fi systems and exponentially increased the outreach to communities and families receiving early warnings. However, internet and mobile technology must be given to every single leader and individual that wants it. This technology has enabled access to adaptation information, post-disaster guidance, governance information and development advice. Now satellite internet is possible in the most remote areas with just a solar panel, small dish and hand-held smart device.

Lessons learned

Very little of the disaster relief money donated to well-known international NGOs and societies actually reached the people on the Western Coast of Santo. Partnership is the ideal approach, with all partners clear about the role they can play, and co-implementation of climate relief and recovery.

Vanuatu has learned lessons since Cyclone Harold with regard to access to finance. For maximum benefit, cash should be provided directly to households so that they themselves can decide best how to use it to meet their own unique contexts. Direct cash assistance, which was piloted for the first time after Cyclone Harold, empowers agency for L&D at the family level, and enables recovery with dignity.

Establishing Community Disaster and Climate Change Committees has been vital for addressing L&D. The SSEN has provided direct support to train them, build their capacity to prepare and respond to crises, and support them long term, well beyond the immediate impacts of the cyclone. Communities possess incredible agency to self-organise and self-support, but only if grassroots action is financed and supported.

For those in Vanuatu, ecosystem services are the foundation of resilience. One of the most important lessons learned is that the official calculations of climate L&D are severely underestimated. This case study has shown that in just one remote area, the costs of damaged and destroyed ecosystem services topped US$39 million, a figure that has not been included in national inventories of building and road impacts. While not easy to calculate, environmental services are the lifeblood of Indigenous communities and quantifying their loss is an essential step towards acknowledging the scale of climate L&D.

Santiago Networks must have both a finance and implementation arm to allow national governments, NGOs and even indigenous civil society to find action-oriented support to cope with L&D.

Synopsis

This case study examines the climate-related L&D of Severe Category 5 Cyclone Harold in 2020 on the people of remote Western Santo Island, and the ecosystems and environmental services on which they depend. This study looks at the non-economic toll of climate change by putting economic valuations on these often-hidden services. Overall, L&D from Cyclone Harold on environmental services and products in a small area of West Coast Santo amounted to US$39.9 million. This included from forest services, crops, building materials for homes and water supply ecosystem services. The case study examines the pivotal role played by an indigenous grassroots network in filling recovery gaps where government and international NGOs cannot. It seeks additional finance, capacity and technology for developing countries to address, minimise and avert the worst impacts of climate change.

Lost communities: the impact of sea level rise and flooding in Pekalongan, northern Java, Indonesia

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Mercy Corps Indonesia



Geography	Southeast Asia; island nation
Location	Pekalongan, Java, Indonesia
Climate hazards	**Slow-onset:** increased rainfall, sea level rise **Rapid-onset:** flooding, land subsidence
Vulnerable groups	Women, children, older people
Response mechanism	**Survival:** sea defences, alternative livelihoods

Context

Indonesia ranks fifth in the world for the size of its population that inhabits lower-elevation coastal zones vulnerable to sea level rise. Approximately 3,000 villages located along the 100,000km coastline experienced flooding between 2016–2018.[1] Indonesia's National Mid-term Development Plan 2020–2024 states that hydrometeorological disasters are expected to intensify in the near and long term due to climate impacts. It predicts rainfall increases in the wet season, together with increases in annual sea level rise.[2] These impacts will increase the severity of flooding in coastal area.

The Greater Pekalongan area on the north coast of Java — comprising Pekalongan City and Regency, and home to a population of 1.2 million — is frequently affected by severe flooding and sea tides.[3] Historical analysis shows that the area experiences high climate variability, contributing to changes in rainfall patterns, and has subsequently increased flood frequency and intensity in the past decades. Data shows that extreme rainfall events occur more frequently — there is higher rainfall intensity and longer rainfall duration in a single event.[4] Historically dry months now experience extreme rainfall. In some instances, flash and tidal floods happen simultaneously and cause devastating impacts, especially to downstream areas that are trapped by flooding from both the sea and rivers.[5]

Currently, the Pekalongan coastal area experiences sea level rises of 5mm per year.[6] The high rate of land subsidence in the area, estimated to be 10–17cm per year between 2012–2018,[7] combined with sea level rise and changes in extreme rainfall patterns, make the area especially vulnerable to flooding. With this in mind, Mercy Corps Indonesia, Diponegoro University and IPB University conducted a climate risk and impact assessment of the Pekalongan City and Regency, including a loss and damage (L&D) study in villages identified as high risk to climate-induced flooding.

Impacts

Climate-induced flooding in the Greater Pekalongan area has created permanent and temporary inundated areas. In early 2020, extreme rainfall events, in combination with tidal flooding, caused 1,478 hectares of inundation. This has unavoidable physical and non-physical impacts. Permanent inundation from flooding, exacerbated by land subsidence, has created a large basin in the coastal area and forced some of the population to relocate. One hamlet is even known as a 'loss hamlet' since the entire 15 hectares is permanently inundated. Even in such difficult circumstances, some residents have opted to stay in these areas due to their socioeconomic conditions, lack of alternative choices, and their cultural and ancestral attachment to the land.

Farmers and fishers are significantly impacted due to the increased flooding as inundated land leads to harvest failure. Another seriously affected livelihood sector is the batik industry — the Pekalongan area is a major producer of Indonesia's traditional textile. Small-scale batik artisans face supply chain disruptions during flood events, in addition to inundation of production sites and homes.

1 BPS (2018) Statistik Sumber Daya Laut dan Pesisir 2018. Jakarta, BPS.

2 Bappenas (2020) National Mid-Term Development Plan 2019-2024. Bappenas, Jakarta.

3 Nashrrullah, S, Aprijanto, T, Pasaribu, J, Manzul, H and Samarakoon, L (2013) Study of flood inundation in Pekalongan, Central Java. International Journal of Remote Sensing and Earth Sciences 10 76-83. DOI: http://dx.doi.org/10.30536/j.ijreses.2013.v10.a1845

4 Mercy Corps Indonesia (2020) Climate Risk and Impact Assessment. https://www.mercycorps.or.id/dokumen/climate-risk-and-impact-assessement-pekalongan

5 Ibid.

6 Kismawardhani, R, Wirasatriya, A and Berlianty, D (2018) Sea Level Rise in The Java Sea Based on Altimetry Satellites Data Over 1993-2015. IOP Conference Series: Earth and Environmental Science. IOP Conference Series: Earth and Environmental Science 165(1):012006. DOI:10.1088/1755-1315/165/1/012006

7 Tempo. (2019). Penurunan Tanah Terparah Peneliti ITB Save Pekalongan. https://tekno.tempo.co/read/1284106/penurunan-tanah-terparah-peneliti-itb-save-pekalongan

Tidal flooding also impacts the environment in the Greater Pekalongan area. During tidal flood events, the inflow of flood water has corroded physical structures and damaged the coastal fish ponds' water quality, making them unfit for farming. An impact assessment in 24 villages with a high- to very high-risk profile, puts total annual economic losses from flooding at around US$474.4 million in 2020 from material loss, non-material loss (mental health and household conflict) and land productivity and ecosystem loss (tourism).

Decadal climate predictions indicate an increase in the frequency and intensity of extreme rainfall in the Greater Pekalongan area, particularly in the upstream. The combination of sea level rise (projected at 0.81cm/year) and land subsidence (projected between 0–34.5 cm/year) is expected to increase the severity of flooding. A fourfold increase of the inundated area in Greater Pekalongan is predicted, from the current 1,478 hectares in 2021 to 5,721ha by 2035, submerging 90% of Pekalongan City and the majority of Pekalongan Regency coastal area. Most the inundated land is currently used for agriculture, aquaculture and residential purposes. For Pekalongan City, the percentage of residential area predicted to be inundated reaches a staggering 100-times increase, from 0.5 to 51% between 2020–2035, having a potentially huge impact. In 2035, it was predicted that 41 villages in Kupang watershed of Greater Pekalongan will be at high flood risk with total potential annual economic losses of US$2.152 billion.[8]

Compounding risks/impacts created

Poor watershed and water resource management has contributed to an increasing severity of flood risks in Greater Pekalongan. Around 21% of Kupang and Sengkarang watersheds, which are the primary sources of the state-owned water company's water supply, are in an ecologically critical state, affecting the watershed's water supply functions.[9] In 2020, the utility company was only able to serve 40% of the Pekalongan City and 11% of the Regency population respectively.[10] The services are considered unreliable due to low water flow and intermittent supply, especially during the dry season. The area also faces water quality challenges, as surface water is polluted due to industrial and domestic activities. Unreliable water supply services and a lack of alternative water sources have led to a dependency on groundwater for both domestic and non-domestic purposes, including the water requirement by over 2,600 batik producers.[11] This condition then contributes to significant land subsidence in the area.

The rate of land subsidence is alarming, ranging from 0–34.5 centimeters (median 16.5cm) per year, with coastal and downstream areas experiencing the highest rates of subsidence.[12] The rapid and high rate of land subsidence has contributed to permanent inundation of villages in coastal areas and has forced some of the community members to relocate from their ancestral lands. Most of the affected households work in the fisheries sector, and therefore relocation results in lost income. As a result, those who have opted to stay in the permanently inundated areas are faced with the difficult task of transforming their livelihood practices and social habits to withstand climate impacts and losses.

In 2019, almost 9% of the Greater Pekalongan population were poor households struggling to meet daily basic needs.[13] These people are particularly vulnerable to climate impacts. Flooding has forced such socioeconomically vulnerable households to deal with a variety of losses and damages (L&D) — assets and

8 Mercy Corps Indonesia, op cit.

9 Watershed and Protected Forest Management Center (BPDASHL) (2019) Performance Report of Gangsa and Kupang Watershed. BPDASHL, Central Java.

10 BPS Kota Pekalongan (2021) Kota Pekalongan Dalam Angka 2020. BPS, Pekalongan; BPS Kabupaten Pekalongan (2021) Kabupaten Pekalongan Dalam Angka 2020. BPS, Pekalongan.

11 Interview with Pekalongan City Local Development Planning Agency, conducted by Mercy Corps Indonesia in 2020, during primary data collection process for CRIA scoping analysis stage.

12 Mercy Corps Indonesia, op cit.

13 BPS Kota Pekalongan (2020) Kota Pekalongan Dalam Angka 2020. BPS, Pekalongan; BPS Kabupaten Pekalongan (2020) Kabupaten Pekalongan Dalam Angka 2020. BPS, Pekalongan.

productive land, market disruptions from flooding and permanent inundation, and service disruption from infrastructure damage. All these result in an increase in basic living costs.

Finally, the COVID-19 pandemic has compounded the existing socioeconomic and environmental risks. The local government has had to reallocate more than 50% of their flood response budget for the COVID-19 response, reducing support to inundated areas in the short term. Mid- and long-term recovery initiatives which consider climate resilience in the short and long terms, are critical for addressing the challenges of inundation in the Greater Pekalongan area.

Vulnerabilities/impacts by compounding risks

More than 80% of the survey respondents in 41 villages in high flood-risk areas are directly affected by flooding, and 63.1% of the respondents stated that flooding has posed a major impact on their livelihoods.

There are various land-use and economic activities taking place in the flood-affected coastal areas of Pekalongan City and Regency.[14] Agriculture and aquaculture activities take place in the east, and aquaculture activities dominate the west.[15] Agriculture and aquaculture are natural resources-dependent livelihoods, and the loss and disruption to this productive land has affected the economic income of farmers. Those with limited savings are forced to shift their livelihood to daily wage labour. This livelihood change requires the population to learn new skills, which for some may proves diffficult due to social, economic and cultural reasons. Additionally, for non-agricultural-based livelihoods (batik entrepreneurs, traders, services, transportation), flooding poses a mobilisation challenge as people are prevented from carrying out business activities.

COVID-19 further crippled the community's economy due to falling market demand, which automatically reduced production and consequently reduced the number of workers engaged in production activities. For example, COVID restrictions resulted in limited tourism and market activity. As a result, there were reduced sales of souvenir and batik artisan products.

Around 50% of the population in the two watersheds are women, and nearly 31% are children and elderly. Around 81% make up vulnerable people with a limited adaptive capacity.[16] Climate-induced flooding greatly affects women, children and elderly people. Almost 93% of children who frequently face tidal floods in Tirto Districts experience moderate anxiety, and 29% of them have mild depression.[17] Tidal floods in the area have also led to domestic violence against women. Further, female-headed families in the high flood-risk villages comprise 35% of the population,[18] and work in climate-vulnerable sectors such as agroforestry, fishery and batik textile production. In such families, as the family head, women bear additional responsibilities for households as breadwinners and caregivers, leading to additional financial, physical and mental pressure during disaster times such as flooding. Furthermore, more than 80% of batik workers out of the 500 Pekalongan batik producers are women. Despite being key actors in the economy, women are often paid less than men, and lack access to economic and social safety nets, which make them more vulnerable to climate-induced flooding than men.[19]

14 Mercy Corps Indonesia, op cit.

15 Mercy Corps Indonesia, op cit.

16 BPS Kota Pekalongan (2020) Kota Pekalongan Dalam Angka 2020. BPS, Pekalongan; BPS Kabupaten Pekalongan (2020) Kabupaten Pekalongan Dalam Angka 2020. BPS, Pekalongan.

17 Rahmawati, FL (2012) Pengaruh Current Ratio, Inventory Turnover, dan Debt to Equity Ratio terhadap Return on Assets (Studi pada Perusahaan Food and Beverage yang Listing di Bursa Efek Indonesia tahun 2007-2009). Universitas Negeri Malang.

18 Mercy Corps Indonesia, op cit.

19 Rusmamariana A, (2020). Identifiksi Trauma Dampak Rob pada Anak di Kabupaten Pekalongan. Jurnal Ilmiah Kesehatan Vol XIII, No II. ISSN 1978-3167, E-ISSN 2580-135X

Adaptation measures

The Greater Pekalongan area community — especially those in the north — have made voluntary adaptations in response to the tidal flood phenomena, such as building embankments, elevating roads, houses, and so on. The government also created larger flood defences, including a sea wall. However, these structural responses will only provide short-term benefits as they are battling significant rates of land subsidence.

The sea wall is a mitigation action carried out by the provincial and local government for addressing tidal flooding. This three metre-high structure, that will be equipped with a pumping system and water gate, is expected to be effective in protecting the Greater Pekalongan area from tidal flooding for the next 25 years.[20] In addition, due to a sequential budget allocation process, its construction is piecemeal, being carried out when budget becomes available. This has resulted in new areas being inundated in locations not covered by the embankment from the run-off flow from both the coast and the river. The sea wall also creates a dilemma during flash floods and urban floods. So far the pump system and water gate are yet to be constructed. As a result, the sea wall blocks and traps run-off water from upstream and midstream for a longer period on the mainland, and during extreme rainfall the trapped water overflows to the surrounding area.

Voluntary adaptation measures also reflect in the livelihood changes made by the community. Historically, the Greater Pekalongan area is famous for coastal jasmine and paddy. However, continuous flooding in productive land has forced the farmers to transform their farmlands to aquaculture. The prolonged and intense flooding gradually created permanently inundated areas, destroying their productive land and forcing farmers to adopt wage labour and other informal vocations as new livelihood options. The community has had to completely alter their livelihoods due to the sustained impacts of climate risks.

Loss and damage beyond adaptation

A L&D calculation was conducted in the high-risk villages/*kelurahans* across four categories:

- Material loss (costs for adaptation and repair, medical costs, additional cost of clean water needs, additional food costs, additional energy costs, loss of income and additional costs for sustaining livelihood practices)
- Non-material loss (psychological impacts and household social disruptions such as domestic violence)
- Land productivity loss, and
- Ecosystem service loss (tourism service).

L&D due to flooding in the area is predicted to reach US$2.1 billion per year by 2035 from US$474.4 million in 2020. This includes US$1.17 billion in material losses, US$806 million in non-material losses, US$5 million in land productivity; and more than US$174 million in ecosystem services loss.[21]

Economic and non-economic adaptation costs and impacts to households are significant due to income loss, additional costs for livelihood activities, and a reduction in land productivity. Loss of income due to tidal flooding in the high-risk villages is predicted to reach US$171 million annually. The three livelihood sectors of trade and service, aquaculture, and farming will be especially affected, due to market and material distribution disruption, inundation, and flood defence measures.

The total projected estimation of economic and non-economic loss for flooding is summarised in Figure 1.

20 Mercy Corps Indonesia, op cit.

21 Mercy Corps Indonesia, op cit.



Figure 1: total economic and non-economic loss Pekalogan City (left) and Pekalongan Regency (right) in thousand US$

Source: data used with permission from: Mercy Corps Indonesia (2020) Climate Risk and Impact Assessment. www.mercycorps.or.id/dokumen/climate-risk-and-impact-assessement-pekalongan

Simonet, a hamlet in Semut village in Pekalongan Regency, with a total area of 15 hectares, has almost completely disappeared due to inundation and tidal flooding. Tidal flooding in Simonet is a daily occurrence. The height of floods can reach up to five metres, forcing residents to evacuate. The local district government decided to provide one hectare of land for ten families who agreed to relocate from the hamlet. Now, the government is preparing to relocate the remaining 67 households (162 people). However, relocation is also a difficult decision since the majority of the residents work in the fisheries sector and need to live along the coast to sustain their livelihood.

Figure 2, below, highlights the economic and non-economic loss and damage suffered in Pekalongan City and Pekalongan Regency.

Recapitulation of total economic and non-economic loss (thousand USD)				
	Pekalongan City		Pekalongan Regency	
Components	**2020**	**2035**	**2020**	**2035**
Affected area (sub-districts/villages)	11	25	13	17
Economic Loss				
Adaptation Cost	81,345	385,512	42,838	113,078
Asset repairment cost	16,651	89,459	24,462	59,205
Medical cost	5,325	35,661	5,902	14,119
Additional cost for water	13,677	69,709	7,890	19,397
Additional cost for food	11,176	56,566	10,943	25,488
Additional cost for energy	7,387	45,197	7,602	18,713
Wastewater treatment	9,074	53,515	7,031	17,599
Income reduction	13,243	110,932	5,020	13,057
Increase in business cost	4,319	36,315	2,383	5,936
Total Economic Loss	162,198	882,866	114,071	286,592
Non-economic Loss				
Mental health	32,047	200,536	19,424	48,237
Household system disruption	71,023	471,280	29,271	89,119
Total Non-economic Loss	103,070	671,815	48,695	137,356
Decrease in land productivity				
Farming	355	465	751	535
Fish-pond	267	303	742	1,604
Total Land Productivity Loss	622	768	1,493	2,139
Ecosystem service loss (for tourism only)	21,522	118,982	22,741	53,079
Total	**287,410**	**1,674,431**	**187,000**	**479,166**

Figure 2: recapitulation of total economic and non-economic loss (thousand US$)

Source: adapted with permission from: Mercy Corps Indonesia (2020) Climate Risk and Impact Assessment. www.mercycorps.or.id/dokumen/climate-risk-and-impact-assessement-pekalongan

The situation in Simonet illustrates how L&D might still be experienced by the community despite adaptation measures, showing the limitation of adaptation.

Support needed in future

Policies, laws and regulations at the national, provincial and city/regency levels influence flood risk management in Pekalongan City and Regency. A policy analysis was conducted to identify existing gaps in current planning policies to mitigate future L&D. Both Pekalongan City and Regency face intertwined spatial and water resource management challenges. With most of its administrative area located upstream, managing upstream and midstream areas are particularly important to Pekalongan Regency. This will ensure their watershed can maintain its critical function in supporting important aspects of development, such as flood management, water resource and other ecosystem functions, as well as economic development opportunitites with proper and sustainable management. Pekalongan City, located downstream of the watershed needs to reduce inundated areas by implementing sustainable urban drainage systems, controlling water flow, fostering groundwater infiltration and using a retention pond to retain and regulate water discharge to water bodies.

Flooding in Pekalongan provides empirical evidence on a situation where adaptation efforts are facing multiple challenges, not only in terms of technical and financial capacity, but also due to irreversible slow-onset events caused by climate change. The adaptation and disaster policy frameworks both at national and global levels have not effectively incorporated these characteristics and the local community continues to bear the costs.

It is necessary to understand that L&D occurs because of limited adaptation. While some conventional disaster risk reduction (DRR) might be relevant, it will not sufficiently meet the current and emerging needs on L&D. Therefore, it is imperative to understand the gap and limitation of current adaptation and DRR mechanisms, how international L&D mechanisms could address the gap, and how the three components can work together.

Support should be provided for vulnerable developing countries to make the best of their efforts in averting, minimising and addressing L&D. This should include slow-onset events, non-economic losses, comprehensive risk management towards sustainable development, and human mobility such as migration, displacement and planned relocation.

A dedicated financing facility for L&D is also crucial, and should not take too long to be disbursed. This must provide support following events, as well as to help the country prepare for L&D in the medium to long term.

Lessons learned

A risk-informed planning process with a comprehensive risk management approach, as exercised in the Greater Pekalongan area, allows policymakers to understand the different climate risks and their contributing factors. This will enable them to shape future policy and their potential impacts.

City and regency governments directly face the impact of climate risks, yet, their hands are often tied due to administrative and agency boundaries, as well as limited financial and technical capacity. From our experience, taking a multi-level governance approach, where national, sub-national and local government are engaged simultaneously, allows each stakeholder to understand the issues beyond their administrative and jurisdiction boundaries. It also fosters understanding of the issues' root causes and how they link together, while allowing for more effective resource allocation.

Synopsis

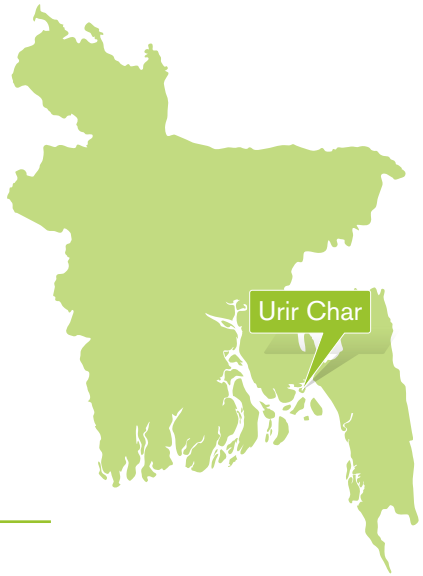
The Greater Pekalongan area on the north coast of Java is among Indonesia's coastal areas frequented by severe flooding due to sea level rise, extreme rainfall and urban planning challenges. Permanently inundated areas have caused people to relocate or completely transform their livelihoods, with implications for their socioeconomic status and cultural belonging to the land.

The Climate Risk and Impact Assessment conducted by Mercy Corps, in collaboration with IPB University and Diponegoro University, sheds a light on the dynamics of climatic and non-climatic factors in shaping flood risks and impacts in the Greater Pekalongan area. Climate and flood analysis predict a fourfold increase of inundated areas, as well as economic losses between the period of 2020–2035.

To deal with the impacts firsthand, it is necessary to create an international financing mechanism for L&D, as well as national policies and frameworks that support local governments.

Washed away: the impact of climate change-induced coastal erosion in Urir Char, Bangladesh

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Geography	Least developed countries; Asia; river island
Location	Urir Char, Bangladesh
Climate hazards	**Slow-onset:** coastal erosion **Rapid-onset:** cyclones, flooding
Vulnerable groups	Women, children, farmers
Response mechanism	**Anticipatory:** cyclone shelters, afforestation **Survival:** Khas land **Recovery:** micro-finance programmes

Context

This case study has been developed based on one key informant interview (KII) with a former Union Parishad Secretary (1988–2012), Belayet Hossain (56), and in-depth interviews (IDIs) with two people from the study area. While the IDIs share human stories and profile vulnerability at the individual level, the KII covers the situation at the community level. Further data was retrieved from secondary literature.

According to the World Bank, Bangladesh is currently ranked as one of the world's most disaster-prone countries, with 97.1% of its total area and 97.7% of the total population at risk of multiple hazards, including cyclones.[1]

Char refers to the island which is formed naturally and is erosion prone due to natural and human-induced stresses. Urir Char was selected as the study area. According to government sources,[2] Urir Char is a river island located next to Sandwip (another island) under the Chittagong district in southeastern Bangladesh. The island was formed in 1970–71. The first generation that settled in this char had relocated from Sandwip in 1980/81, due to coastal erosion taking away their land. Urir Char was named after a variety of grass called 'Uri' that was growing on the island. According to Belayet Hossain (56) (KII respondent), the estimated population of the island is 20,000, including the homeless.

Impacts

Coastal erosion is the most crucial climate stressor in the area. Belayet Hossain said that 4km of land has been eroded in the last ten years and 10km in last 35 years from the south and west respectively, although char land shifted from the south to the north. However, the annual rate of accretion of Urir Char Island has decreased from 5.84km^2 per year between 2007–2010, to 1.05km^2 per year between 2010–2013.[3] This incessant and rapid erosion has frequently displaced people. One of the IDI respondents, Abul Kalam (56), has been displaced seven times within Urir Char since 1981. Earlier his family was displaced from the nearby island (Sandwip) due to coastal erosion. There are many similar stories of displacement in this char. Thousands of families have been displaced and rendered homeless frequently due to coastal erosion and cyclones.

Coastal erosion has always happened on the islands, but climate change has caused the erosion rate to increase in recent years, with sea level rise having a long-term effect on coastal erosion in Bangladesh.[4] Coastal erosion has eroded two-thirds of Urir Char.

Climate change means cyclone and drought intensity and frequency are also high. Any rise in sea surface temperature due to climate change is likely to be accompanied by an increase in cyclone frequency.[5] Urir Char has faced many climate extreme events in the last 30 years, including the 1985 flood and the cyclones of 1991, 2007 (Sidr) and 2009 (Aila). However, the 1985 and 1991 extreme climatic events caused the most loss and damage (L&D).[6]

According to Belayet Hossain, drought has been more acute in 2021 and damaged fish and crops, the main income source of people in Urir Char. Different cyclones in 1985, 1991, 2007 and 2009 killed

1 Chowdhury, AMR, Bhuyia, AU, Choudhury, AY and Sen, R (1993) The Bangladesh cyclone of 1991: why so many people died. *Disasters*, 17(4), 291–304.

2 https://tinyurl.com/y2x4k3tk

3 Hussain, MA, Tajima, Y, Gunasekara, K and Sohel, R (2014) Recent coastline changes at the eastern part of the Meghna Estuary using PALSAR and Landsat images. IOP Conference Series: Earth and Environmental Science 20(1) 012047.

4 Ali, A (1999). Climate change impacts and adaptation assessment in Bangladesh. Climate research, 12(2-3), 109-116.

5 Ibid.

6 https://tinyurl.com/y2x4k3tk

thousands of people and domestic animals, and damaged crops and properties. A study found 40% of family members were lost in Urir Char in 1985.[7] Flood and other stressors have caused frequent and incessant losses in this unprotected char land. But coastal erosion remains the main cause of all L&D.

Compounding risks/impacts created

The population in Urir Char is economically deprived, marginalised and excluded from mainstream society. The literacy rate in Urir Char (26%)[8] is comparatively lower than the national literacy rate (74.68%).[9] Currently, people living in Urir Char are the most vulnerable people in the region, facing coastal erosion, cyclones, drought and so on.

Coastal erosion is the main cause of poverty, low literacy rate, unemployment and poor infrastructure at household and community level in Uri Char. Belayet Hossain said: "Although the people of this island are poor and marginalised, coastal erosion and other climate stressors enhance their marginalisation and vulnerability. They are always in trauma with the pain of losing their beloved things and accommodation again and again."

Every household in Urir Char has faced displacement three to seven times. Biadhan (70), who lost all her sons in the 1985 cyclone, has been living with relatives who are struggling with poverty. The family has 11 members but a single earner. They were also displaced three times due to coastal erosion.

Vulnerabilities/impacts by compounding risks

Socially and economically vulnerable people were the first generation to live on this island. In Bangladesh, women face more difficulties than men during disasters and emergencies.[10] According to a Human Rights Watch study, natural disasters like coastal erosion and cyclones encourage child marriage. Families who see their land eroding rush to marry off their daughters before they are displaced.[11] Women feel insecure when they have to leave for new settlements. There is also a risk of gender-based violence, including domestic violence, sexual violence, sexual exploitation and abuse, child/early marriage and trafficking. Female-headed families are more vulnerable. Biadhan, who lost seven children in the 1985 cyclone, had lost her husband just prior to the event. She said: "If my husband was alive during the cyclone, it would have been different. I could have tried to save my children. My husband died just before the 1985 flood."

Due to economic stagnation and lack of educational institutions on the island, it is a common phenomenon for children in Urir Char to drop out of school. Belayet Hossain said: "Many children in our community drop out of school due to erosion-induced displacement. However, some of our children are studying outside by leaving their family at a very early age. They struggle alone outside. They feel like an outcast in mainstream society."

Cultural loss

Displaced people also lose their support network as they leave their neighbours behind. They feel like outsiders in the new settlement and are marginalised economically and socially. When paddy fields and fish farms are lost to coastal erosion, people suffer not only from livelihood losses but a change in their

7 Siddique, AK and Eusof, A (1987) Cyclone deaths in Bangladesh, May 1985: who was at risk. *Tropical and geographical medicine*, 39(1), 3–8.

8 https://en.wikipedia.org/wiki/Urir_Char#:~:text=Urir%20Char%20has%20a%2026.4%25%20literacy%20rate.%20It,The%20island%20has%2015%20mosques%20and%208%20eidgahs

9 https://www.theglobaleconomy.com/Bangladesh/Literacy_rate/

10 UN Women (2014) Baseline Study on the Socio-Economic Conditions of Women in Three Eco-Zones of Bangladesh.

11 HRW (2015) Climate Change is Forcing Bangladeshi Girls into Child Marriage. Human Rights Watch Study. https://www.hrw.org/news/2015/06/09/climate-change-forcing-bangladeshi-girls-child-marriage

environment, with the loss of green fields and pond water. Mosques, places of rituals and other heritage sites are also commonly lost due to erosion in Urir Char.

Adaptation measures

Government officials have made many promises to build a cross dam, block dam or embankment, but so far there has not been much progress made on these. Abul Kalam said the construction of a dam was planned earlier to save the vulnerable people from coastal erosion and cyclones, but these are yet to materialise.

The government's ASROYON (shelter) project aims to protect displaced people. However, this is not considered effective, as they only provide accommodation. There is no provision for creating livelihoods for the displaced people.

Community-based initiatives sometimes work to protect people during disasters. Khas land (newly accredited char land) is the last resort for displaced people, but these lands are controlled by locally powerful people and not allotted fairly, with the poor and vulnerable being excluded. Char Development Settlement Project (CDSP) is responsible for land allocation on char lands.

Afforestation initiatives were undertaken to reduce the impact of cyclones, but the trees have been destroyed by coastal erosion. External donors also constructed many cyclone shelters, but these too were lost to coastal erosion. A total of 292 cyclone shelters were built by the government and given to the island's residents who had lost their houses during the 1985 cyclone.[12] Belayet Hossain said the Indian government constructed 100 individual buildings and one cyclone shelter after the 1985 cyclone. The Pakistan government constructed a large mosque and the Bangladesh government constructed 170 individual buildings and cone cyclone shelter building. But all have been lost within five years. Government and foreign donors have been building many cyclone shelters since 1985, but those have also been lost to coastal erosion.

Cyclone shelters can provide minimum protection for displaced people, but the local disaster management and cyclone shelter management committees are not functioning properly. Some local NGOs are trying to improve the livelihoods of displaced people through micro-finance programmes, but higher interest rates make the initiatives unfeasible. Sometimes government and non-government relief is also available but these are not enough. Government has taken the initiative to supply electricity, but again little progress has been made, due to erosion.

Belayet Hossain said: "A few electricity pillars were lost to coastal erosion. Nothing can be sustainable in Urir Char due to erosion, be it cyclone shelter, educational institution or electricity."

The community is also deepening their ponds to save water for drought season, but according to the respondents, these were not sustainable and efficient due to prolonged drought, particularly in 2021.

Loss and damage beyond adaptation

Abul Kalam (50) lost his home and agricultural land seven times due to coastal erosion, estimated to be worth 1 crore BDT. He once had a business but now he is unemployed and does not practise agriculture. He has two sons who are also unemployed.

He said: "Incessant coastal erosion made us poor economically and marginalised socially. We cannot build our house and have to prepare for cultivating land again and again. This erosion killed our youth, our life and the future of our next generation."

12 Chowdhury, A. M. R., Bhuyia, A. U., Choudhury, A. Y., & Sen, R. (1993). The Bangladesh cyclone of 1991: why so many people died. *Disasters* 17(4) 291-304.

There are economic and non-economic L&Ds caused by coastal erosion. Coastal erosion resulted in the loss of agricultural land. Cyclone and drought decreased the fertility of land in an area where agriculture is the backbone of the local economy. The loss of fertile agricultural land used for cultivation is a big economic loss for the area.

Belayet Hossain said: "Coastal erosion, cyclone and drought have made people of this land bankrupt. Recently, prolonged years of drought resulted in loss of fish and crops. This impacted all families as there is no electricity for pumping water for fish farming during drought."

Thousands of lives were also lost due to the cyclones in 1985 and 1991. These events are still traumatic for those who survived, as many bodies were not found and the dead could not be given a proper burial.

"Women, Persons with Disability (PwD) and elderly are abandoned during disasters as they cannot move quickly during a cyclone," said Biadhan, an elderly respondent. People are not aware of the safety requirements of PwD and elderly people, making them highly vulnerable to cyclones. Economically and socially marginalised people are also most vulnerable. They are being displaced permanently in urban areas as they do not have the money to buy land.

For the people in Urir Char, the hope for a cross dam and block dam, promised by the government in 2015 and 2020 respectively has been in vain as there is no action on the construction of these structures. Belayet Hossain said: "We are really upset as already one year has passed since the human chain and visit of government official, but there is no development on block dam construction to protect this char land."

Some L&D cannot be measured in economic value. The pain of losing loved ones, house and property is lifelong for people. People in Urir Char work hard to construct their homes and prepare their agricultural land, which is then lost multiple times to coastal erosion. As a result, people suffer from psychological trauma all their life.

Khas land (newly formed char land) is the last resort for displaced people, but these are controlled by locally powerful people. Despite government efforts on afforestation, the Khas lands are also eroded and people are using them for cultivation to meet the needs of the growing population.

Support needed in future

To save the land from erosion, dam construction is urgently needed. Support for increasing the number of cyclone shelters and improving the condition of existing ones is also necessary. To help erosion-induced displaced people, especially women, the elderly and people with disabilities, temporary shelters must be built, and water, sanitation and hygiene services provided.

Electricity is needed to supply water during droughts for crop protection and fish farming. An economic and social reintegration process is also needed to mainstream displaced people into new settlements where they move after displacement.

Further research on these issues is required. Using technology to assess L&D and manage coastal management should be facilitated through scientific research. People need to be trained to face coastal erosion and cyclones with coping and adaptation mechanisms.

Lessons learned

Although the Bangladesh government and foreign governments have tried to reduce the climate-induced risk in this Char land since 1985, a lack of coordination, funding constraints and policy gaps have stalled progress on implementing disaster management initiatives.

Advocacy at a national and international level may lead to the discovery of solutions to address climate change-induced vulnerability. While the government has promised to construct an embankment, no further action has been taken. Inter-ministerial coordination at national level would help to change the fate of these vulnerable people living in the Char Lands. Community-based disaster risk reduction (DRR) initiatives are also required.

Although many climate stressors are active in this char land, coastal erosion is the most crucial stressor. It has made people vulnerable during cyclones and climatic events.

Synopsis

Urir Char, a river island in south-eastern Bangladesh, has been eroded by two thirds since its formation. Many climate stressors are active here, including coastal erosion, cyclones, drought and heavy rainfall. Coastal erosion is most acute and a stress multiplier when we assess climate change-induced loss and damage. Women, children, elderly people and people with disabilities are the most vulnerable to displacement caused by coastal erosion and the effects of displacement. While many initiatives have been implemented to reduce the impact of cyclones (constructing shelters, afforestation, allotting khas land for displaced people, supplying electricity to reduce the impact of drought), they have been in vain: coastal erosion has washed them away. Therefore, solving the coastal erosion problem will pave the way to solving other climate change-induced problems in the region.

The cost of rising seas: how climate change is impacting life on Tuvalu, Pacific Ocean

Author: Richard Gokrun
Tuvalu Climate Action Network (TuCAN)



Geography	Small Island Developing State; low-lying island nation
Location	Tuvalu, Pacific Ocean
Climate hazards	**Slow-onset:** sea level rise, saltwater intrusion, increasing temperatures, ocean acidification **Rapid-onset:** cyclones, flooding
Vulnerable groups	Women, disabled people, Indigenous communities
Response mechanism	**Anticipatory:** disaster planning **Survival:** sea defences, relocating fruit trees, water storage

Context

This case study concerns Tuvalu in the global South, in particular Funafuti, Nanumea, Niutao, Nanumaga, Nui, Vaitupa, Nukulaelae and Niulakita.

Tuvalu is one of the smallest nations in the world, comprising several isolated low-lying islands in the Pacific Ocean between Australia and Hawaii. Tuvalu has a tropical climate, with consistently high temperatures throughout the year (27°C–29°C) and high mean annual precipitation (2,500–3,000mm) (see Figure 1). November to April is tropical cyclone season, and May to October is the dry season. Since 1950, the minimum air temperatures have risen 0.24°C per decade and since 1970, sea surface temperatures have risen 0.13°C per decade.[1] The country is also regularly experiencing high maximum temperatures but in a stable temperature regime. The probability of heat waves is growing significantly as the difference between historical average temperature and current average temperatures increases. The country is facing challenges in the wet season and in the dry season. From June to September, low rainfall is prolonging the dry spell. Consequently, freshwater availability is decreasing, and the probability of groundwater contamination by salt intrusion is rising.

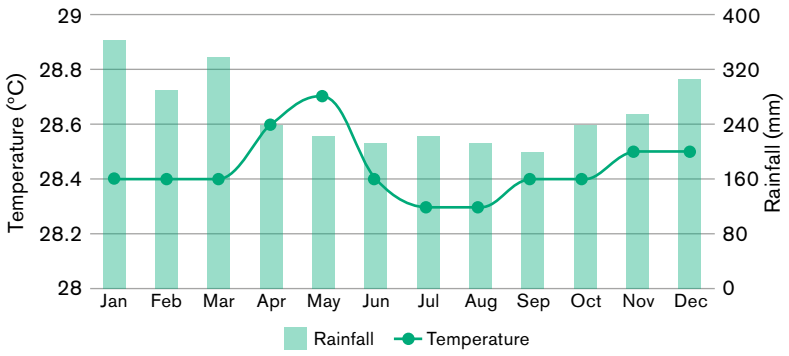


Figure 1: average monthly temperature and rainfall in Tuvalu (1991–2020)

Source: adapted from Climate Risk Country Profile: Tuvalu (2021): The World Bank Group and the Asian Development Bank (via CC BY-NC 3.0 IGO). https://climateknowledgeportal.worldbank.org/sites/default/files/2021-06/15824-WB_Tuvalu%20Country%20Profile-WEB.pdf

Adding to that, frequent tropical storms in the wet season (October to March) are causing extensive damage to the infrastructure and agricultural land. Saltwater intrusion is affecting crops and fruit-bearing trees. An increase in surface temperature leads to coral lightening and impacts marine life, degrading fish stocks, particularly tuna. These changes severely impact Tuvalu's coastal areas, especially when they coincide with the month's king tides or neap tides.

Impacts

Sea level rise has had severe impacts on the citizens of Tuvalu. For example, the groundwater is no longer safe for drinking due to saltwater contamination. This threatens the country's water security and also poses a significant threat to the health of local citizens, making them vulnerable to water-borne diseases.

Livelihoods are adversely impacted in the agriculture sector. Saltwater intrusion affects soil fertility and causes most local root crops — traditionally grown by communities and individual families — to wither. The local fisherman have livelihood concerns, as they report smaller catches at fishing spots compared to past decades. In addition, many fishermen have noted that they have to travel much further into the ocean, to catch tuna (skipjack). Tuna moving further away from land is linked to increases in sea surface temperatures.

Similar impacts have also been noted within the ecosystem and biodiversity. A decline in natural resources pushes many citizens to think about migrating out of the country for a more secure future.

1 Climate Risk Country Profile: Tuvalu (2021): The World Bank Group and the Asian Development Bank. https://climateknowledgeportal.worldbank.org/sites/default/files/2021-06/15824-WB_Tuvalu%20Country%20Profile-WEB.pdf

The impacts of climate variability make issues around infrastructure and property very challenging. For instance, climate-proof infrastructure is urgently needed, but this requires strong materials to replace local building material — and these come at a high price that most communities or individuals cannot afford.

Disputes over land ownership have also arisen in recent times. When land is washed away by tides, the affected landowner stakes claims to the neighbouring land boundary, often prompting a court case or even physical assaults.

Compounding risks/impacts created

The compounding risk to climate change in Tuvalu depends on the occurrence and intensity of tropical cyclones, sea level rise, saltwater intrusion, drought and so on. An extended period of low rainfall on the different islands of Tuvalu will increase the possibility of drought in future. The increasing population is also creating pressure on the island environment, food security and livelihood. Since most of the islands are low-lying, increasing sea level rise will also increase the risk of coastal erosion, saltwater intrusion, flood and so on. Other direct impacts of sea level rise are increases in vector-borne and water-borne diseases and human stress. Agricultural yield will also decrease due to saltwater contamination of groundwater. Frequent tropical cyclones and extreme events in Tuvalu will create pressure on the sustainability of the Pulaka pit plantation. The combined effect of high temperature and saltwater intrusion will also increase pest infestation, and as a consequence, the yield of fruits will decrease.

Climate-induced impacts place a financial burden on people to standardise or upgrade their standard of living to adjust to the changing context. People living below the poverty line have pressurised the government for financial assistance to upgrade their living conditions. The poor infrastructure puts those residing in areas vulnerable to cyclones at high risk of evacuation to a safer place. The impacted communities often hold the government responsible for the damages caused by natural disaster.

Vulnerabilities/impacts by compounding risks

Tuvalu is highly vulnerable to climate change because all the islands of Tuvalu are susceptible to sea level rise. According to one estimate, by the end of the 21st century, global sea levels will rise by up to 0.79m.[2] According to the Intergovernmental Panel on Climate Change (IPCC), more significant rises may also be possible due to melting ice in Greenland and Antarctica.[3] Currently, erratic climate and extreme weather events in Tuvalu include tropical cyclones, coastal erosion, sea level rise and frequent dry spells. These have adversely affected domestic agricultural production, fresh water availability and communities' livelihood options. Saltwater intrusion caused by sea level rise affects a plant's growth and consequently, decreases food crop production, hampering food security. In addition, frequent cyclones and storm surges increase the stress on infrastructure like roads and housing, as well as other sectors like electricity, water, agriculture, fisheries, health and so on. These are the most vulnerable sectors in Tuvalu.

Tuvalu is also facing severe economic development challenges. The country has minimal natural resources distributed in different islands. The domestic economy of this country is also very small. Due to the country's geographical location, international tourism and trade are expensive and infrastructural facilities

2 Bindoff, NL, Willebrand, J, Artale, V, Cazenave, A, Gregory, J, Gulev, S, Hanawa, K, Le Que´re´, C, Levitus, S, Nojiri, Y, Shum, CK, Talley, LD and Unnikrishnan, A (2007) Observations: oceanic climate change and sea level. In: Solomon, S, Qin, D, Manning, M, Chen, Z, Marquis, M, Averyt, KB, Tignor, M, Miller, HL (Eds.) *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge and New York.

3 IPCC (2007) Summary for policymakers. In: Solomon, S, Qin, D, Manning, M, Chen, Z, Marquis, M, Averyt, KB, Tignor, M, Miller, HL (Eds.) *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge University Press, Cambridge and New York.

are very weak.[4] According to World Bank estimates, in 2010, 26.6% of Tuvalu's population was living under the national poverty line.[5] The number of jobless and economically inactive people increased from 19% in 2004–5 to 24% in 2010.[6] As in other regions, most of the climate change events excessively impact the poorest sections of society.

The climate hazards in Tuvalu are described in Figure 2.

	Climate hazard	Description
1	**Sea level rise**	Rising sea levels in coastal areas mean the sea is increasingly encroaching higher ground on already eroded and vulnerable coastlines. This increases the coastal area subjected to coastal erosion and flooding.
2	**Saltwater intrusion**	Rising sea levels and the porous soils of Atoll Islands create the ideal conditions for inland saltwater intrusion and the increasing salinity of groundwater lenses.
3	**Inundation**	Rising sea level pushes water closer to the land surface, resulting in upwelling at low-lying areas across the island — high frequency of inundation at Pulaka pits.
4	**Drought**	Increasing frequency of El Niño–Southern Oscillation (ENSO), associated erratic rainfall and periods of low rainfall leads to household water shortage with increasing stress on groundwater lenses, affecting all biomes dependent on groundwater resources.
5	**Cyclones**	Severe destruction of vegetation, crops, and humans from strong tropical cyclone winds leads to flooding that increases breeding areas for vector-borne diseases.
6	**Rising sea surface temperatures**	Rising sea surface temperatures have and will continue to affect coral bleaching, decreasing productivity of near-shore coral reef ecosystems and affecting the communities whose principal protein source comes from the sea.

Figure 2: climate hazards in Tuvalu

Source: adapted from Ministry of Natural Resources, Environment, Agriculture and Lands (2007) Tuvalu's National Adaptation Programme of Action: Under the auspices of the United Nations Framework Convention on Climate Change. Tuvalu: Department of Environment. https://unfccc.int/resource/docs/napa/tuv01.pdf

Women are highly vulnerable as their voices are not heard at the community level, where most decisions are taken by men. The same is true for other marginalised groups, including Indigenous People, with minority voices not being heard or considered in most situations. Disabled people and children are often involved in meetings as observers and not in the actual decision making.

Also, at the community level, a privileged few have access to basic services due to their involvement in community work and religious practices. This is a concern where there is inequity, marginalisation and violation of human rights protocols. Many communities have been displaced both internally within Tuvalu and externally to other countries due to the impact of loss and damage to infrastructure and land. This shows Tuvalu's vulnerability to severe climate impacts and the threat to the lives of residents. People have to explore other countries for a safe future.

Internal displacement, loss of land to sea rise, population growth and distribution have resulted in an increase in land disputes and increased competition for the unsustainable harvesting of available resources. The loss of customs is among the first impacts of climate change for people migrating to other countries and adopting new cultures and customs. Rituals and cultural heritage are lost in diaspora communities as they are no longer being practised.

4 Pacific Economic Bulletin (2003) Volume 18, Number 2. Asia Pacific Press. http://devpolicy.org/PEB/sort-by/issue/2003-volume-18-number-2/

5 World Bank (2016) Poverty headcount ratio at national poverty lines (% of population). http://data.worldbank.org/indicator/SI.POV.NAHC/countries/TV?page=1&display=default

6 Tuvalu (2016) Te Kakeega III: National Strategy for Sustainable Development 2016 to 2020. Government of Tuvalu. https://www.adb.org/sites/default/files/linked-documents/cobp-tuv-2017-2019-ld-02.pdf

Adaptation measures

The government and NGOs have implemented many adaptation activities to reduce the adverse impacts of climate change. These include disaster planning, a plant-a-tree programme, relocating local fruit trees between the islands, developing community water tanks and so on. The government has also constructed the sea wall on Nanumaga, with community involvement, to reduce saltwater intrusion on the Island. However, in some areas, the sea wall has collapsed, and saltwater intrusion has continued. The government has assisted the families who were severely affected by saltwater intrusion. The government and NGOs have also created water storage facilities for the communities, to address the problem of freshwater availability. To reduce vulnerabilities in different sectors, the government has taken some sectoral adaptation initiatives, described in Figure 3.

Sl No.	Sectors	Adaptation Initiatives
1	**Coastal**	Increasing resilience of coastal areas and settlement to climate change
2	**Agricultural**	Increasing subsistence pit-grown pulaka productivity by introducing a salt-tolerant pulaka species
3	**Water**	Adaptation to frequent water shortages by increasing household water capacity, water collection accessories, and water conservation techniques
4	**Health**	Strengthening community health through control of vector-borne/climate-sensitive diseases and the promotion of access to quality potable water
5	**Fisheries**	Strengthening community-based conservation programmes on highly vulnerable near-shore marine ecosystems
6	**Fisheries**	Adaptation to near-shore coastal shellfish fisheries resources and coral reef ecosystem productivity
7	**Disaster**	Strengthening community disaster preparedness and response potential

Figure 3: adaptation initiatives in Tuvalu, by sector

Source: adapted from Ministry of Natural Resources, Environment, Agriculture and Lands (2007) Tuvalu's National Adaptation Programme of Action: Under the auspices of the United Nations Framework Convention on Climate Change. Tuvalu: Department of Environment. https://unfccc.int/resource/docs/napa/tuv01.pdf

In most communities, adaptation measures such as reviving traditional knowledge in food security and food safety have been encouraged, as this knowledge helps to preserve food for a long period and supports good health. There are also efforts to build community sea walls to avoid coastal erosion and to create artificial bedding to grow crops and vegetables at a height where saltwater intrusion cannot reach. Some of these efforts turned out well but their long-term sustainability is not guaranteed as most adaptation measures require significant financial assistance to pay for upgrades and maintenance.

It is difficult to maintain such adaptation measures as the rate and severity of impacts progress much faster than the measures can be taken up by the community.

Loss and damage beyond adaptation

Some impacts are beyond adaption and cannot be avoided, such as the loss of landmass and drinking water. Loss of lands causes disputes as the affected landowners claim the boundary of inland landowners. The scale of these L&Ds to the people in Tuvalu is considerable. The economic losses include losing land for farming and the reduction of space for livelihoods and breeding animals, all of which affect family earnings.

Non-economic L&Ds include a change of diet because of local custom. When burial sites are washed away by strong sea swells, they leave corpses in the main residential settlements. In this case communities do not consume local foods for a long period of time as they believe the food to be contaminated and the fish to have fed on the remains of the corpses. This has affected traditional lifestyles by forcing people to switch from local to imported foods.

Frequent cyclone and storm surges pose a continuous threat to the daily life of Tuvalu's people. In 2015, at the time of Cyclone Pam, an estimated 45% of the population were impacted, and the country lost US$10.3 million, about 26.9% of its GDP (Gross Domestic Product).[7] All of Tuvalu's islands have experienced tidal floods and tropical cyclones with agriculture and infrastructural losses. According to climate data, increasing temperatures, sea level rise and ocean acidification are regular events associated with climate change in Tuvalu.

Support needed in future

The following areas have been identified:

1. Technical assessments of each island in the context of climate change, to identify feasible techniques for coastal protection.
2. Financial support to assist people who choose to migrate elsewhere and for those who need to stay on and adapt.
3. Integration of adaptation activities into the sectoral development plans, through inclusive training on climate change issues. Policymakers need to devise strong policies to deal with climate change.
4. Leaders of developing countries must consider the impacts of Small Island Developing States and cut down their emissions levels immediately.

Lessons learned

This case study identifies some barriers to the implementation of adaptation activities. These include a lack of national adaptation awareness, a lack of integration of adaptation activities into developmental plans, and a lack of advanced technological know-how and knowledge on sectoral priorities to reduce the impact of climate change.

Lack of national adaptation awareness: climate change awareness is very low at all levels, from policymakers to grassroots-level civil society organisations. Capacity building on climate change issues at all levels is essential, so that every individual can understand the adverse impact of climate change on their livelihoods. This information should be provided in the local language.

Lack of integration of adaptation activities into developmental plans: Tuvalu does not have appropriate law for protecting and conserving the environment or regulating environmental degradation. To properly implement the adaptation activities, the incorporation of national sectoral development plans is necessary.

Advanced technological know-how and knowledge on sectoral priorities to reduce the impact of climate change: implementation of adaptation activities requires appropriate tools, knowledge and methodologies for decision making.

Synopsis

This case study highlights the high vulnerability of the Islands of Tuvalu to the impacts of climate change. With its limited resources and technical capacity, there is little the country can do to adapt to the impacts of climate change. More information must be shared with citizens about the vulnerabilities they face and their struggle to adapt to the impacts.

7 Tuvalu (2016), op cit.

Loss and damage is an urgent issue: the world's least-resourced communities and countries are increasingly unable to adapt to or absorb worsening climate impacts. Greater international support is overdue, but the realities and costs of loss and damage remain poorly understood and information is not systematically shared.

This resource presents 12 case studies from diverse locations in the global South experiencing loss and damage from slow- and rapid-onset climate events. Authored by local civil society, experts, university researchers and NGOs from the global South, with the support of expert mentors, each case study provides evidence on the challenges, possible responses and support needed to address loss and damage. Together, they capture the bigger picture, with transferable lessons on effective response and highlighting the universal need for support.

Created primarily for stakeholders from climate-vulnerable countries looking for practical solutions and for advocates seeking evidence to inform international and national policy discourse. With forewords by the Rt Hon Alok Sharma MP and Prof Dr Saleemul Huq.



Knowledge Products

Toolkit

October 2021

Climate change; Policy and planning

Keywords:
Loss and damage, climate resilience, floods, droughts, extreme weather events

This work was made possible through the support of Climate Emergency Collaboration Group, a sponsored project of Rockefeller Philanthropy Advisors.

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