

ASSESSING POST DISASTER RECOVERY IN PHALOMBE DISTRICT: LESSON FROM TROPICAL CYCLONE FREDDY

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ABSTRACT

This study assessed the multi-dimensional community recovery and resilience in Phalombe District, Malawi, more than two years after the devastating impacts of Tropical Cyclone Freddy in March 2023. Drawing on the official Phalombe District Council District Civil Protection Committee (DCPC, 2023) report and primary data collected from the most affected Traditional Authority Jenala, the research examined social, economic, infrastructural, and environmental dimensions of recovery with the aim of evaluating the extent to which "build back better" principles had been applied. A mixed-methods approach was employed, combining structured questionnaires with 30 purposively selected affected households, one focus group discussion, two key informant interviews with the Disaster Risk Management Officer and a Search and Rescue team member, and GIS-based land use and land cover (LULC) change detection analysis between 2022 and 2025. Findings reveal partial and uneven recovery. Social services such as school attendance and basic health access have largely resumed, yet economic recovery remains weak with average household monthly income declining by approximately 52% (from MWK 50,700 to MWK 25,300), farming productivity still low for 80% of households, and infrastructural recovery limited with only about 7% of damaged houses rebuilt to resilient standards and many roads and bridges still inaccessible during the rainy season. GIS analysis further confirmed environmental degradation, with vegetation cover decreasing by 6.72% and bare land increasing by 8.35%, exacerbating soil erosion and flood risk. The study concludes that while short-term humanitarian assistance was effective, long-term resilience-building has been inadequate, leaving communities highly vulnerable to future disasters. These findings underscore the need for more coordinated, sustainable recovery strategies in flood-prone areas of Malawi. Recommendations include scaling up long-term livelihood support, prioritizing resilient housing and infrastructure rehabilitation, strengthening community preparedness, and improving multi-stakeholder coordination to genuinely "build back better."

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ACRONYMS/ABBREVIATIONS

DCPC:	District Civil Protection Committee
DoDMA:	Department of Disaster Management Affairs
DRMO:	District Risk Management Officer
FGD:	Focus Group Discussion
GIS:	Geographic Information System
IPCC:	Intergovernmental Panel on Climate Change
KII:	Key Informant Interview
LULC:	Land Use and Land Cover
MWK:	Malawian Kwacha
NGO:	Non-Governmental Organization
QGIS:	Quantum GIS (open-source GIS software)
T/A:	Traditional Authority
UNDRR:	United Nations Office for Disaster Risk Reduction
NDVI:	Normalized Difference Vegetation Index

1. CHAPTER ONE: INTRODUCTION

1.1 Background

Tropical cyclones are among the most destructive natural hazards globally causing widespread flooding, wind damage, landslides, and long-term socio-economic disruption, with recovery processes often spanning many years. In the context of climate change, the frequency and intensity of such cyclones are projected to increase, placing greater pressure on vulnerable communities and fragile infrastructures (IPCC I. P., 2022). Malawi, a landlocked but highly exposed country in southern Africa, has experienced a rising trend of climate-related disasters, with its southern region repeatedly affected by intense rainfall, floods, and cyclones.

Phalombe District, located in southern Malawi, exemplifies this vulnerability. Characterized by steep hills, deforested slopes, and weak drainage systems, the district is predominantly rural and heavily dependent on rain-fed subsistence agriculture (maize, pigeon peas, rice, and cassava). Most households rely on small-scale farming and livestock rearing for their livelihoods, making the local economy especially sensitive to environmental shocks (DoDMA D. o., 2023). On 11 March 2023, Tropical Cyclone Freddy made landfall in Malawi after an unprecedented two crossings of the Indian Ocean. The cyclone triggered catastrophic flooding, strong winds, and mudslides across Phalombe District, particularly in Traditional Authorities Jenala, Nazombe, and Nkhulambe. The official post-disaster assessment by the Phalombe District Council District Civil Protection Committee (DCPC, 2023) recorded that 58,031 households were affected, 28,343 houses were damaged or destroyed, 26,178 people were displaced into over 100 temporary camps, and critical infrastructure including roads, bridges, health facilities, markets, and water-sanitation systems was severely compromised. Agriculture and natural resources suffered equally devastating losses, 17,167.4 hectares of crops were destroyed and 65,242 livestock perished.

Disaster recovery is no longer viewed merely as a return to pre-disaster conditions. Contemporary international frameworks, most notably the Sendai Framework for Disaster Risk Reduction (UNDRR U. N., 2015), emphasize the need for “building back better”, a

holistic process that simultaneously restores physical infrastructure, revitalizes economies, rebuilds social cohesion, rehabilitates the environment, and strengthens community resilience to future hazards. Despite this global consensus, state-of-the-art knowledge on post-cyclone recovery in rural African settings remains limited, especially regarding the integration of official district-level statistics with detailed grassroots experiences and geospatial evidence of environmental change. While immediate humanitarian response in Malawi has received considerable attention, far less is documented about the multi-dimensional, long-term recovery trajectory more than two years after the event. This study therefore situates itself within this knowledge gap by examining the social, economic, infrastructural, and environmental dimensions of recovery in Phalombe District, using primary data collected directly from the most affected communities in Traditional Authority Jenala, supplemented by the official (DCPC, 2023) report and GIS-based land-use and land-cover analysis.

1.2 Problem Statement

Although immediate help after Tropical Cyclone Freddy saved many lives in Phalombe District, the long-term recovery has been slow and uneven. More than two years later, many families still live in weak or temporary houses, their monthly income has dropped by about 52%, farming output remains low because of soil erosion and lack of money, and many roads and bridges are still difficult to use during the rainy season. Community unity is weaker than before, and psychological support is not enough. The main problem is that recovery efforts have focused mostly on short-term relief instead of building back better for the long term. As a result, communities in Phalombe remain very vulnerable to future disasters. This is shown by official reports (DCPC, 2023)and information collected directly from affected families.

1.3 Main Objective

The main objective in this research is to assess community recovery and resilience in Phalombe District following Tropical Cyclone Freddy (2023).

1.4 Specific Objectives

1. To assess social recovery in affected communities.

2. To evaluate economic recovery of households and livelihoods.

3. To examine infrastructural recovery.

1.5 Research questions

1. How have communities in Phalombe District socially recovered following Cyclone Freddy?

2. What is the extent of economic recovery among affected households and livelihoods?

3. To what extent has infrastructural recovery progressed in Phalombe District following Tropical Cyclone Freddy?

1.6 Significance of the Study

This research is significant because it provides a clear and honest picture of long-term community recovery in Phalombe District more than two year after Tropical Cyclone Freddy. By combining official district statistics (DCPC, 2023) with primary data collected directly from affected households, focus group discussions, key informant interviews, and GIS land-use analysis, the study offers valuable evidence on what has worked and what has not in the recovery process. The findings highlight important gaps in economic recovery, housing reconstruction, infrastructure repair, and environmental rehabilitation. This information will help government agencies, NGOs, and development partners design more effective, long-term recovery programs that truly "build back better" and strengthen community resilience. Ultimately, the study contributes useful knowledge that can guide future disaster recovery efforts not only in Phalombe but also in other flood-prone districts across Malawi and southern Africa.

2. CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature related to post-disaster recovery following climate-related disasters, with particular emphasis on tropical cyclones and floods. The chapter critically examines empirical and theoretical scholarship on disaster vulnerability, recovery processes, humanitarian response, infrastructure rehabilitation, livelihood restoration, environmental recovery, and resilience building. It further explores global, regional, and national perspectives on post-disaster recovery and analyses policy frameworks relevant to disaster recovery management. Finally, the chapter identifies gaps in existing literature that justify this study on assessing post-disaster recovery in Phalombe District following Tropical Cyclone Freddy.

2.2 Understanding Disasters and Post-Disaster Recovery

Disasters are increasingly recognized not simply as natural events but as the interaction between environmental hazards and socially constructed vulnerabilities (Wisner, 2004). Although hazards such as floods, cyclones, droughts, and landslides occur naturally, the extent of their impact depends largely on social, economic, environmental, and political conditions that shape people's exposure and coping capacities (Adger, Social capital, collective action, and adaptation to climate change, 2003).

The Pressure-and-Release (PAR) model developed by (Wisner, 2004) explains that disasters occur when hazards intersect with root causes such as poverty, weak governance, environmental degradation, poor land-use planning, and limited livelihood opportunities. These factors create unsafe conditions that increase vulnerability and reduce the ability of communities to recover after disasters.

Climate change has intensified the frequency and severity of hydro-meteorological hazards globally, particularly in low-income countries with weak adaptive capacities (IPCC I. P., 2022). According to (Hallegatte, 2017), poor communities are disproportionately affected because they often lack resilient infrastructure, diversified livelihoods, savings, and access

to recovery resources. Consequently, disasters frequently reinforce existing poverty and inequality.

Post-disaster recovery refers to the process through which affected communities restore and improve social, economic, environmental, and infrastructural systems following disasters (Olshansky, 2009). Recovery includes reconstruction of homes and infrastructure, restoration of livelihoods, rehabilitation of environmental systems, and strengthening of institutional and community resilience.

Recovery is increasingly viewed not simply as returning communities to pre-disaster conditions but as an opportunity to reduce future vulnerability and improve resilience. This perspective is reflected in the "Build Back Better" concept, which advocates reconstruction processes that strengthen infrastructure, institutions, preparedness systems, and livelihood capacities beyond their pre-disaster state (Clinton, 2006).

2.3 Global Perspectives on Post-Disaster Recovery

Globally, post-disaster recovery has become an important component of disaster risk management and sustainable development. International frameworks increasingly emphasize that recovery should integrate resilience building and disaster risk reduction measures to minimize future losses (UNDRR U. N., 2015).

The concept of resilience has become central within disaster recovery discourse. (Folke, 2006) defines resilience as the ability of individuals, communities, and systems to absorb shocks, adapt to change, and recover while maintaining essential functions. Communities with strong social cohesion, diversified livelihoods, effective institutions, and preparedness systems are generally more capable of recovering from disasters.

The "Build Back Better" (BBB) framework emerged prominently following the 2004 Indian Ocean tsunami and later became integrated into global disaster recovery policy (Clinton, 2006). The framework advocates reconstruction processes that improve pre-disaster

conditions through safer infrastructure, improved land-use planning, environmental rehabilitation, stronger governance systems, and enhanced preparedness mechanisms.

UNDRR (UNDRR, 2017) argues that effective recovery should integrate disaster risk reduction into reconstruction processes through resilient housing standards, early warning systems, climate-resilient infrastructure, and sustainable environmental management. (Fernandez, 2019)further emphasize that successful recovery requires long-term investment, institutional coordination, and community participation rather than short-term humanitarian assistance alone.

Despite growing global commitment to resilience-oriented recovery, many developing countries continue experiencing slow and incomplete recovery processes due to poverty, weak governance systems, inadequate institutional coordination, and limited financial resources (Der Sarkissian, 2023). Consequently, affected communities often remain vulnerable to future disasters even after recovery interventions.

2.4 Tropical Cyclones and Disaster Recovery in Southern Africa

Southern Africa has experienced increasing frequency and intensity of tropical cyclones over recent decades due to climate change and warming ocean temperatures (IPCC I. P., 2022). Cyclones Idai (2019), Ana (2022), and Freddy (2023) caused widespread destruction across Malawi, Mozambique, Zimbabwe, and Madagascar.

Cyclone Idai exposed major weaknesses in disaster preparedness, infrastructure resilience, and recovery systems within Southern Africa (World, 2019). Studies conducted after Cyclone Idai found that recovery efforts were heavily dependent on external donor support and often failed to adequately strengthen long-term resilience (GFDRR, 2019).

Cyclone Freddy became one of the longest-lasting and most destructive cyclones recorded in Southern Africa. In Malawi, the cyclone caused extensive flooding, mudslides, displacement, infrastructure destruction, agricultural losses, and environmental degradation (DoDMA D. o., 2023).

Research by (Braka F. D., 2024) found that Cyclone Freddy significantly affected social determinants of health including access to sanitation, healthcare, nutrition, shelter, and safe water systems. Similarly, (Lutala, Cyclone Freddy in Malawi: Reflections from a primary care perspective., 2023) observed severe disruption of healthcare delivery systems in affected districts following the cyclone.

The disaster also generated serious social and psychological impacts. (Kangoma, Mental health impact of the 2023 Tropical Cyclone Freddy.., 2023) documented increased trauma, stress, and mental health challenges among affected populations, particularly women and vulnerable households (Twabi, Cyclone Freddy and its impact on maternal health service utilisation..., 2024) further found that maternal healthcare utilization declined significantly because damaged roads and transport systems limited access to health facilities.

Environmental impacts associated with Cyclone Freddy included severe soil erosion, destruction of vegetation, river sedimentation, and loss of agricultural productivity (MacLeod C. e., 2025). These environmental damages continue to threaten food security and livelihood recovery in affected districts such as Phalombe.

The literature therefore demonstrates that post-disaster recovery following tropical cyclones requires integrated approaches that address social, economic, environmental, infrastructural, and institutional dimensions simultaneously.

2.5 Humanitarian Assistance and Recovery Processes

Humanitarian assistance plays a critical role in addressing immediate survival needs after disasters through provision of food, shelter, healthcare, sanitation, and emergency protection services (IPCC I. P., 2022). Following Cyclone Freddy, humanitarian agencies, government institutions, NGOs, and development partners implemented emergency response interventions across affected districts including Phalombe (DoDMA D. o., 2023).

These interventions included food aid, temporary shelters, healthcare support, cash transfers, psychosocial services, and rehabilitation of damaged infrastructure. Such interventions helped reduce immediate suffering and prevented further humanitarian deterioration among affected populations.

However, scholars increasingly argue that long-term recovery requires transitioning from emergency relief toward sustainable recovery and resilience-building interventions (UNDRR U. N., 2015). Recovery programs should strengthen community capacities, restore livelihoods, improve infrastructure resilience, and reduce future disaster risk.

Cash-based assistance has emerged as an important recovery mechanism because it allows households flexibility in prioritizing their recovery needs while stimulating local economic recovery (Committee, 2025). Agricultural recovery programs, livelihood diversification initiatives, and environmental rehabilitation projects also contribute significantly to sustainable recovery outcomes.

Nevertheless, studies indicate that post-disaster recovery in developing countries often remains incomplete due to inadequate funding, delayed reconstruction, weak institutional coordination, and poor implementation of "Build Back Better" principles (Hofmann, 2022).

In Malawi, recovery interventions following major disasters have frequently focused more on emergency humanitarian assistance than long-term resilience strengthening (Malawi, National Disaster Recovery Framework., 2017). As a result, many communities continue experiencing recurring vulnerability and repeated disaster losses.

2.6 Post-Disaster Recovery in Malawi

Malawi is highly vulnerable to floods, droughts, cyclones, and other climate-related hazards because of environmental degradation, poverty, weak infrastructure systems, and heavy dependence on rain-fed agriculture (Malawi, Malawi 2015 floods post-disaster

needs assessment, 2015). Southern districts such as Phalombe frequently experience flooding, landslides, and storm-related destruction during heavy rainfall seasons.

Research on disaster recovery in Malawi demonstrates that recovery processes are often slow, uneven, and incomplete. Following the 2015 floods, (Malawi, Malawi 2015 floods post-disaster needs assessment, 2015) assessments showed that many households struggled for years to rebuild homes, restore livelihoods, and regain food security.

(Trogrlić, 2022) argue that community-based disaster risk reduction initiatives in Malawi often fail to adequately incorporate indigenous knowledge systems and local participation. Weak institutional coordination and dependence on external humanitarian actors reduce sustainability of recovery interventions.

(Kayamba-Phiri, 2023) emphasize that sustainable recovery in Malawi requires stronger community-led disaster management systems, improved early warning systems, and enhanced institutional capacities at local level. Similarly, (Manda S. &., 2025) observed that institutional weaknesses and political challenges significantly affected preparedness and response during Cyclone Freddy.

Livelihood recovery remains particularly difficult in rural Malawi because most households depend heavily on subsistence agriculture and possess limited financial resources. (Hallegatte, 2017) note that poor households recover more slowly because they lack savings, diversified income sources, insurance systems, and access to financial support.

Environmental degradation further complicates recovery processes. Deforestation, soil erosion, and declining vegetation cover increase vulnerability to flooding and reduce agricultural productivity (MacLeod C. e., 2025). This creates a cycle where environmental decline reinforces livelihood insecurity and long-term disaster vulnerability.

The literature therefore suggests that effective post-disaster recovery in Malawi requires integrated approaches combining livelihood restoration, resilient infrastructure

reconstruction, environmental rehabilitation, institutional strengthening, and community preparedness systems.

2.7 Theoretical Framework

This study is guided by Resilience Theory and the Sustainable Livelihoods Framework (SLF).

Resilience Theory explains how individuals, communities, and systems respond to shocks while maintaining essential functions (Folke, 2006). The theory emphasizes adaptive capacity, social cohesion, institutional strength, learning processes, and flexibility in responding to disasters.

The theory is relevant to this study because it helps explain why some communities recover more effectively than others following disasters. Communities with diversified livelihoods, strong social networks, effective institutions, and preparedness systems are generally more resilient to hazards.

The Sustainable Livelihoods Framework developed by (Chambers, 1992) complements resilience theory by examining how households utilize assets and capabilities to sustain livelihoods under changing conditions. The framework identifies five key livelihood assets namely human, social, financial, physical, and natural capital.

Disasters often destroy these livelihood assets, thereby increasing vulnerability and slowing recovery processes. Consequently, recovery interventions should strengthen livelihood assets while reducing vulnerability to future hazards.

Together, these frameworks provide a comprehensive analytical lens for assessing post-disaster recovery in Phalombe District following Tropical Cyclone Freddy.

2.8 Conceptual Framework

The conceptual framework for this study proposes that post-disaster recovery outcomes are influenced by interactions between disaster impacts, humanitarian interventions, institutional coordination, and community resilience capacities.

Tropical Cyclone Freddy caused widespread destruction of livelihoods, infrastructure, housing, environmental systems, and social services in Phalombe District. Humanitarian interventions including food aid, temporary shelters, healthcare services, cash transfers, and infrastructure rehabilitation were implemented to address immediate needs.

However, long-term recovery outcomes depend on several mediating factors including:

- Quality of humanitarian assistance
- Institutional coordination
- Community participation
- Livelihood restoration programs
- Infrastructure reconstruction
- Environmental rehabilitation
- Early warning systems
- Disaster preparedness mechanisms

Where recovery interventions successfully integrate "Build Back Better" principles and strengthen resilience capacities, communities are more likely to achieve sustainable recovery. Conversely, weak coordination, inadequate funding, environmental degradation, and limited livelihood support may prolong vulnerability and delay recovery.

2.9 Policy and Institutional Context

Globally, the Sendai Framework for Disaster Risk Reduction (2015–2030) provides the main policy framework guiding disaster recovery and resilience-building efforts. The framework emphasizes understanding disaster risk, strengthening governance, investing in resilience, and enhancing preparedness for effective response (UNDRR U. N., 2015).

The "Build Back Better" principle forms a central component of the Sendai Framework and encourages countries to integrate resilience into recovery, rehabilitation, and reconstruction processes.

Nationally, Malawi's National Disaster Risk Management Policy (2015) and National Disaster Recovery Framework (2017) guide disaster management and recovery activities. These policies emphasize resilience building, environmental management, community participation, and integration of disaster risk reduction into development planning.

The Department of Disaster Management Affairs (DoDMA) coordinates disaster preparedness, response, and recovery activities in collaboration with district councils, NGOs, humanitarian agencies, and development partners.

Despite the existence of these policy frameworks, implementation challenges remain significant due to limited financial resources, weak institutional capacity, poor coordination, and increasing frequency of climate-related disasters.

23.10 Research Gaps

Although substantial literature exists on disaster impacts and humanitarian response in Malawi, limited research has comprehensively examined long-term post-disaster recovery at community level following Tropical Cyclone Freddy.

Most existing studies focus primarily on emergency response, humanitarian assistance, or sector-specific impacts such as healthcare and agriculture. Few studies integrate social, economic, environmental, infrastructural, and institutional dimensions of recovery within a single analytical framework.

Furthermore, limited empirical evidence exists regarding whether recovery interventions in rural Malawi have successfully implemented "Build Back Better" principles and strengthened long-term resilience against future climate-related hazards.

Existing studies also provide limited community-level perspectives regarding how affected households perceive recovery progress, preparedness, and resilience following Cyclone Freddy.

This study therefore addresses these gaps by assessing post-disaster recovery in Phalombe District and drawing lessons from Tropical Cyclone Freddy through household surveys, focus group discussions, key informant interviews, and spatial analysis techniques.

3.CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the methodological framework employed to assess post disaster recovery in TA Jenala, Phalombe district.

3.2 Study Design

This study used mixed-methods research design. This means I collected both numbers (quantitative data) and personal stories and opinions (qualitative data). The study also included GIS mapping to see changes in the vegetation and ecology. The purpose of using mixed methods was to get a complete and accurate picture of how communities in Phalombe District recovered after Tropical Cyclone Freddy. Numbers showed how much recovery had happened, while stories from people explained why and how it happened. Possible problems with this design:

Some people might not remember exact details from before the cyclone correctly (recall bias). Also, because only 30 households were studied, the results may not apply to the whole district. However, I reduced these problems by using official government reports and talking to different people to check the information.

Dependent variables in this study include social recovery (school attendance, community unity, preparedness), Economic recovery (household income and farming output), Infrastructural recovery (houses, roads, water, and health facilities) and Environmental recovery (vegetation health and ecological recovery). Independent variables include the impact of the cyclone itself, and the type of help (aid) people received after the cyclone.

3.3 Study Area

The study was conducted in Traditional Authority (T/A) Jenala, Phalombe District, in southern Malawi. Phalombe District is characterized by steep hills, deforested slopes, and weak drainage systems, making it highly prone to flooding, landslides, and soil erosion (DoDMA D. o., 2023). Most residents depend on subsistence agriculture, mainly maize, pigeon peas, rice, and cassava. T/A Jenala was purposively selected because it was one of the area's most severely affected by Tropical Cyclone Freddy in March 2023, with

widespread destruction of houses, crops, roads, and infrastructure (DCPC, 2023). The total study area covered approximately 288.3 km².

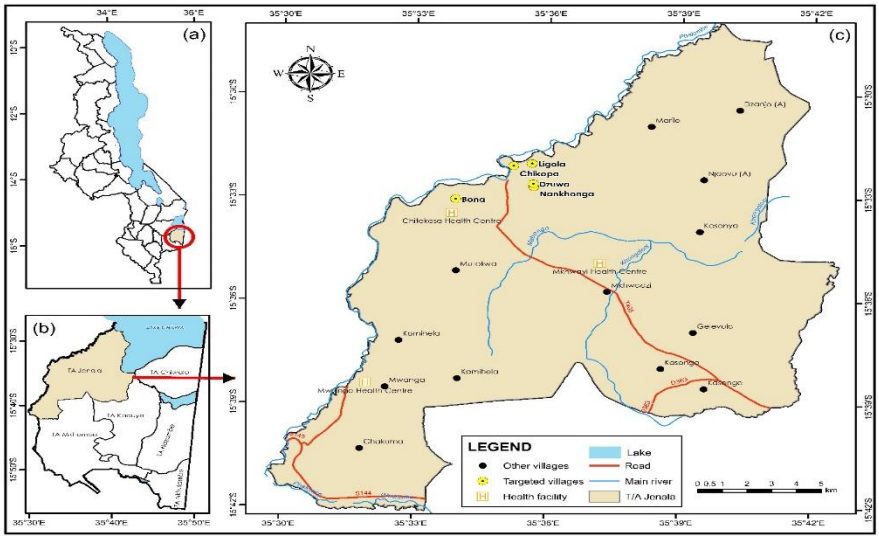


Figure 1Study area map for T/A Jenala, Phalombe district

3.4 Sampling design

3.4.1 Population and Sample Size

Thirty (30) affected households in T/A Jenala were purposively selected to participate in the study. Purposive sampling was used because I wanted households that had been directly and severely impacted by the cyclone and could provide detailed information about their recovery experiences and due to limited resources but the sample size for my study was 44 respondents. The inclusion criteria were: (1) the household must have been living in T/A Jenala during Cyclone Freddy in March 2023, and (2) the household must have experienced damage to housing, crops, or livelihood.

Informed consent was obtained from all participants before data collection. Participation was voluntary, and respondents were informed that they could withdraw at any time without any consequences. Confidentiality was maintained by using code numbers instead of names. All participants gave written or verbal informed consent.

$$n=\frac{N}{1+N(e)^2}$$

Where n = sample size, N = population size, and e = margin of error (0.15). Substituting the values:

$$n = \frac{12775}{\mathbf{1}+12775(\mathbf{0.15})^2} = \mathbf{44.44}$$

Therefore, the sample size was **44 people.**

Accordingly, a sample of 44 respondents was targeted for the study, but I purposely chose 30 respondents due to resources.

3.5 Data Collection Instruments and Procedures

A mixed-methods approach was used to collect both quantitative and qualitative data.

3.5.1 Structured Household Questionnaires

Data was collected from the 30 selected households using both digital and paper-based structured questionnaires. The digital questionnaires were designed and administered using Kobo Toolbox on mobile phones. Paper questionnaires were used as a backup in areas with poor network coverage. The questionnaire contained both closed and open-ended questions on housing conditions, monthly income before and after the cyclone, access to education and health services, farming productivity, road accessibility, water sources, and overall recovery ratings.

3.5.2 Focus Group Discussion (FGD)

One focus group discussion was conducted with 8–10 community members (men, men and youths) to capture collective experiences, coping strategies, and challenges faced during the recovery process.

3.5.3 Key Informant Interviews (KIIs)

Four key informant interviews were carried out: one with the District Risk Management Officer (DRMO) and one with an executive member of the Search and Rescue team, with social officer from social office at Phalombe district council and an officer from infrastructure office. These interviews provided expert insights into recovery efforts, coordination challenges, and support provided by government and NGOs.

3.5.4 GIS and Remote Sensing

Geographical information systems (GIS) were used to generate NDVI maps for 2022, 2023 and 2025 by comparing near infrared and red spectral bands from satellite images. The study utilizes the Normalized difference vegetation index to quantify environmental recovery and vegetation health overtime. NDVI was calculated by comparing the Near Infrared (NIR) and Red spectral bands from satellite imagery using Equation (1):

$$NDVI=NIR-RED/NIR+RED \quad (1)$$

Where:

- **NIR** represents the Near Infrared spectral band
- **RED** represents the Red spectral band

NDVI values range from -1 to +1, where higher positive values indicate healthier and denser vegetation cover, while lower values indicate sparse vegetation, bare soil, or degraded environmental conditions.

A comparative analysis across three distinct phases: 2022, (baseline), 2023(shock) and 2025 (long term recovery). The NDVI results were classified into vegetation density categories ranging from "very low" to "very high" to measure vegetation health and ecological resilience. This classification helped identify changes in vegetation cover, land degradation and ecological recovery over time. All GIS processing was done using QGIS software.

3.7Materials and Instruments

- Kobo Toolbox digital platform (for mobile phone data collection)

- Paper-based structured questionnaires (backup)

- Mobile phones (for administering Kobo Toolbox forms)

- Semi-structured guides for FGD and KIIs

- Notebooks for field notes

- Satellite imagery (freely available multi-spectral images)

- QGIS software (for image classification and change detection)

- Microsoft Excel software (for data entry and analysis)

3.7 Data Processing and Analysis

3.7.1 Quantitative Analysis

Quantitative data collected through Kobo Toolbox and paper questionnaires were exported, coded where necessary, and analyzed in Microsoft Excel. Descriptive statistics including frequencies, percentages, means, and percentage changes were calculated. Tables, bar graphs, and charts were generated to present income changes, house conditions, recovery ratings, and other indicators.

For the GIS component, vegetation density was calculated and presented in a graph. The results from questionnaires, FGD, KIIs, and GIS were triangulated (combined and cross-checked) to ensure reliable and valid findings.

3.7.2 Qualitative analysis

Qualitative data from the FGD and KIIs were analyzed using thematic analysis to identify common patterns and key insights.

3.7.3 Recovery Rating and Classification Criteria

To assess the level of post-disaster recovery in T/A Jenala, the study developed qualitative recovery ratings based on the condition and functionality of key recovery indicators collected through household questionnaires, focus group discussions (FGDs), key informant interviews (KIIs), official district reports, and GIS analysis. Recovery was assessed across four major dimensions: social recovery, economic recovery, infrastructural recovery, and environmental recovery.

The recovery ratings were categorized into four levels:

table 1shows recovery rating description

Recovery Level	Description
Fully Recovered	Most indicators had returned to or improved beyond pre-disaster conditions. Systems and livelihoods were functioning normally with improved resilience.
Moderate/ Partial recovery	Some important recovery progress had occurred, but several indicators remained incomplete or vulnerable. Basic services had resumed, although weaknesses and recovery gaps persisted.
Weak recovery	Limited recovery had taken place. Many households and systems continued experiencing major challenges, losses, and reduced functionality.
Not recovered/ degraded	Very little or no meaningful recovery occurred. Conditions remain severely affected or environmentally degraded compared to pre-disaster conditions.

The classification of recovery levels was based on triangulation of multiple data sources. Quantitative indicators such as school attendance, income levels, housing reconstruction, road accessibility, access to clean water, and vegetation density were combined with qualitative evidence from FGDs and KIIs to determine the overall recovery status within each thematic area.

For example, social recovery was evaluated using indicators such as restoration of education services, community unity, disaster preparedness structures, evacuation planning, and psychosocial wellbeing. Economic recovery was assessed through changes in

household income, farming productivity, livelihood restoration, and livestock recovery. Infrastructural recovery considers the condition of houses, roads, bridges, schools, health facilities, water systems, and irrigation infrastructure. Environmental recovery was assessed using NDVI-based vegetation analysis and evidence of ecological regeneration over time.

This recovery rating approach helped simplify interpretation of findings and allowed comparison between different dimensions of recovery following Tropical Cyclone Freddy.

3.9 Research Ethics

The study adhered to rigorous ethical standards throughout. Institutional permission to conduct the research was sought from the Malawi University of Science and Technology Research Ethics Committee (MUSTREC) and the Phalombe District Council. All participants were fully informed of the study's purpose, voluntary nature, and their right to withdraw without consequence. Informed consent was obtained from each participant prior to data collection. Confidentiality was maintained by replacing participant names with institutional identifiers and anonymized respondent codes. The study adhered to the 'Do No Harm' principle, ensuring that data collection activities posed no physical, emotional, or social risk to participants. Research findings will be used exclusively for academic purposes.

4. CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents and discusses the findings of the study on assessing post-disaster recovery in Phalombe District following Tropical Cyclone Freddy. The results are organized according to the major thematic areas derived from the study objectives and research questions. Section 4.2.1 presents findings on social recovery, including restoration of education services, disaster preparedness structures, community cohesion, and psychological support systems. Section 4.2.2 presents findings on economic recovery, focusing on household income changes, livelihood restoration, farming productivity, and financial recovery challenges experienced by affected households. Section 4.2.3 presents findings on infrastructural recovery, including housing reconstruction, roads and bridges, schools, health facilities, water systems, irrigation schemes, and the application of "Build Back Better" principles during reconstruction. Section 4.2.4 presents findings on environmental recovery based on Normalized Difference Vegetation Index (NDVI) analysis, vegetation regeneration trends, ecological resilience, and long-term environmental impacts of the cyclone. The discussion of findings is integrated within each thematic section and links the empirical evidence obtained from household questionnaires, focus group discussions, key informant interviews, official district reports, and GIS analysis to relevant theoretical frameworks and existing literature on post-disaster recovery, resilience building, humanitarian response, and disaster risk reduction.

4.2Results

4.21 Social Recovery

The study found that social recovery in Traditional Authority (T/A) Jenala, Phalombe District, has made moderate progress more than two years after Tropical Cyclone Freddy. Although essential social services such as education and healthcare have largely resumed normal operations, several aspects of community wellbeing and preparedness remain only partially recovered.

All 30 households (100%) reported that the nearest school was damaged during the cyclone. However, all respondents confirmed that children are currently attending school again, indicating substantial restoration of educational services within the affected communities. This finding was consistent with views expressed during the Focus Group Discussion (FGD) and Key Informant Interviews (KIIs), where participants explained that schools and health facilities had resumed operation despite some infrastructural challenges.

The study found that disaster preparedness committees were present in all surveyed communities. Every household (100%) confirmed the existence of community disaster preparedness structures established after the cyclone. However, improvements in evacuation planning were less evident, with only 50% of households reporting better evacuation arrangements compared to the period before the cyclone, while the remaining 50% indicated that evacuation planning had not improved significantly.

Community cohesion and social unity were found to remain fragile. Household responses showed that no community reported full restoration of social unity. Approximately 40% of respondents described community unity as moderate, while 60% viewed it as weak. Participants during the FGD explained that displacement, loss of family members, destruction of homes, and prolonged economic hardships negatively affected social relationships and community cohesion. Key informants similarly noted that although some progress had been made through community meetings and disaster preparedness initiatives, social recovery remained incomplete in several villages.

The study also established that psychological support services were available in some areas; however, access remained limited and inconsistent among vulnerable groups. FGD participants explained that many affected households continued experiencing emotional stress, trauma, and anxiety related to cyclone impacts and fear of future disasters.

Indicator	Fully Recovered	Partially Recovered	Not Recovered
Children attending school	30 (100%)	0	0
Disaster preparedness committee	30 (100%)	0	0
Evacuation planning improved	15 (50%)	0	15 (50%)
Community unity	0	12 (moderate)	18 (weak)

Table 2 presents the status of social recovery indicators

4.22 Economic Recovery

Economic recovery is weak and incomplete. Household incomes have declined sharply, and most livelihoods have not returned to pre-disaster levels. The average monthly household income dropped from MWK 50,176 before the cyclone to MWK 20,523, now a decline of 56.86%. Most households (90%) of the sample size for my research depended on farming before the cyclone, but many have shifted to small businesses with much lower earnings. Only 20% of households reported improved farming productivity. Livestock losses have largely not been replaced.

Participants in the FGD and the DRMO KII explained that crops were washed away and lack of capital prevented full recovery of businesses and farming. Short-term aid such as cash transfers, seeds, and maize helped reduce hunger, but long-term capital support is still missing.

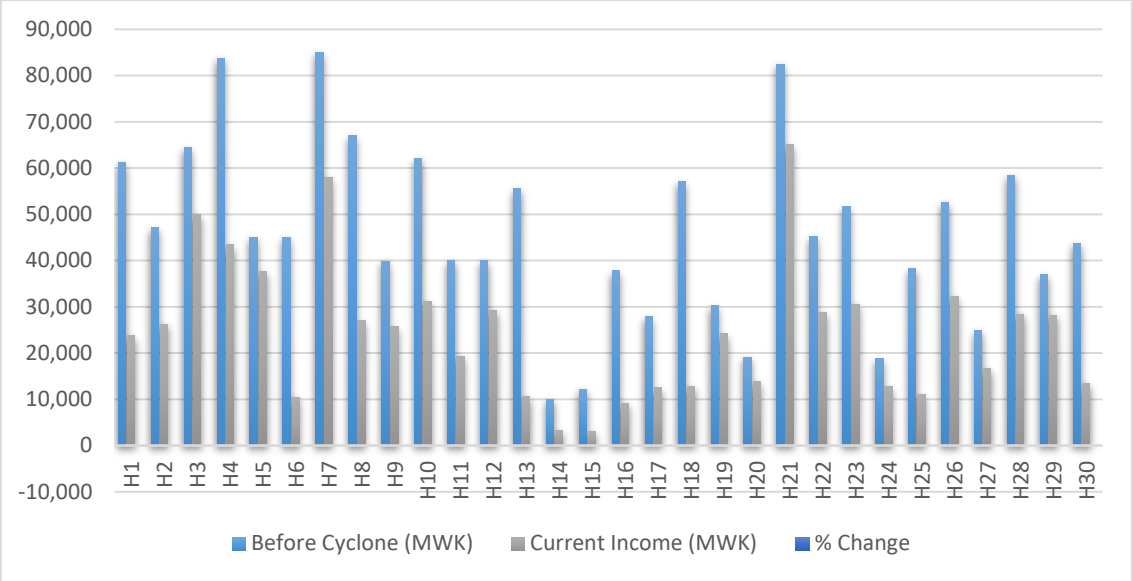


Figure 2Graph of average income before and after tropical cyclone Freddy

4.23 Infrastructural Recovery

The study found that infrastructural recovery in Traditional Authority (T/A) Jenala, Phalombe District, remained partial and uneven more than two years after Tropical Cyclone Freddy. Although reconstruction activities were observed in several communities, many households and critical public infrastructures had not yet recovered to resilient standards. Data from household questionnaires, Focus Group Discussions (FGDs), Key Informant Interviews (KIIs), official District Civil Protection Committee (DCPC) reports, and GIS analysis collectively showed that infrastructural recovery remained incomplete.

4.231 Housing Recovery

Official records from the District Civil Protection Committee (DCPC, 2023) indicated that approximately 28,343 houses were damaged across Phalombe District during Tropical Cyclone Freddy. Household survey findings showed varying levels of housing recovery among affected communities.

Out of the 30 households surveyed:

- 60% were living in reconstructed permanent houses,
- 20% were still residing in temporary shelters, and
- 20% had not fully rebuilt their houses.

Although some households managed to rebuild using stronger materials, many reconstructed houses remained structurally weak and vulnerable to future flood events. FGD participants explained that lack of financial resources and construction materials delayed complete reconstruction.

4.232 Roads and Bridges

The study established that transport infrastructure remained highly vulnerable. Roads and bridges damaged during the cyclone had not been fully rehabilitated, and many became inaccessible during rainy periods.

Participants during the FGD explained that poor road conditions continued to affect mobility, access to markets, schools, and health facilities. Key informants further reported that some bridges were reconstructed temporarily without long-term flood resilience measures.

3 4.233Public Services and Water Infrastructure

The findings revealed better recovery progress in education and health infrastructure compared to housing and transport systems. Most schools had resumed operations, and children had returned to learning activities. Health facilities were also functioning again, although one facility remained partially damaged and not fully operational.

Access to clean water had improved considerably, with approximately 70–80% of households reporting access to safe water sources. However, irrigation systems and flood protection structures such as dykes remain damaged or incomplete, increasing the risk of future flooding and reduced agricultural productivity.

INFRASTRCTURE	Damaged (DPCC)	Status(current) (KII, field)	Build back better applied?
Houses	2843	Only 7% rebuilt	Partial
Roads and Bridges	6bridges 14 roads	Most not accessible during rainy season	No
Health Facilities	9 facilities	Most functional (one not operational)	Partial
Water Sources	Widespread	80% have access to clean water	Partial
Schools	Multiple	Children attend	Yes (some were reconstructed)
Irrigation Schemes	31	Many damaged	Still limited

Figure 3 status of infrastructural recovery



Figure 4 reconstructed bridge along phalombe river

The figure above shows a reconstructed bridge along the Phalombe River after Cyclone Freddy. Although the bridge restored connectivity, respondents reported that the structure remains vulnerable during periods of heavy rainfall and flooding.

4.234 GIS and Satellite Image Analysis

GIS and satellite image analysis showed noticeable environmental and infrastructural changes before and after Tropical Cyclone Freddy. Satellite imagery from 2022 represented pre-cyclone conditions, while 2023 imagery showed the extent of flood impacts and destruction.



Figure 5 satellite imagery (pre-cyclone conditions)

The 2022 satellite image above shows settlement patterns, vegetation cover, and river systems in T/A Jenala before Tropical Cyclone Freddy. The area displayed relatively stable land cover and settlement distribution prior to the disaster.



Figure 6: satellite imagery (post-cyclone conditions)

The 2023 satellite image above illustrates the impact of Tropical Cyclone Freddy, including flooding, damaged vegetation, altered river channels, and expansion of exposed land surfaces caused by erosion and destruction.

The GIS analysis further revealed that reconstruction activities increased after the cyclone, particularly near the Phalombe River. However, some households rebuilt within flood-prone zones, indicating limited application of "Build Back Better" principles during recovery processes.

4.24 Environmental Recovery

The study assessed environmental recovery in Traditional Authority (T/A) Jenala using the Normalized Difference Vegetation Index (NDVI) to measure vegetation health and ecological recovery over time. NDVI analysis was conducted using satellite imagery and QGIS software to compare environmental conditions across three periods: 2022 (pre-cyclone baseline), 2023 (post-cyclone impact period), and 2025 (long-term recovery phase).

The NDVI analysis was used to classify vegetation density into categories ranging from "very low" to "very high" vegetation health. This classification helped evaluate ecological resilience, vegetation regeneration, and environmental degradation following Tropical Cyclone Freddy.

4.2.4.1 Baseline Environmental Conditions (2022)

The 2022 baseline NDVI map showed that T/A Jenala had relatively healthy environmental conditions before Tropical Cyclone Freddy. The area was characterized by dense vegetation cover, productive agricultural land, and relatively stable ecological conditions.

High-density vegetation covered approximately 90.86 km², while areas classified as having very high vegetation health accounted for about 63.58 km² out of the total study area of approximately 289.38 km². Areas with low or very low vegetation density occupied less than 23% of the total land area, indicating that most parts of T/A Jenala had healthy vegetation and productive ecological systems before the cyclone.

4.2.4.2 Post-Cyclone Environmental Degradation (2023)

The 2023 post-cyclone NDVI map revealed substantial environmental degradation caused by Tropical Cyclone Freddy. The analysis showed widespread vegetation loss, exposed bare soil, destruction of crops, and severe ecological disturbance associated with flooding, erosion, landslides, and sediment deposition.

Vegetation density declined significantly in several parts of the study area, particularly near river channels and flood-affected agricultural zones. Areas previously characterized by high vegetation cover shifted into low and very low vegetation categories, reflecting severe damage to both natural vegetation and cultivated farmland.

The findings suggest that the cyclone had major environmental consequences that directly affected ecological stability, agricultural productivity, and household livelihoods within affected communities.

4.2.4.3 Long-Term Environmental Recovery (2025)

The 2025 NDVI analysis showed evidence of gradual vegetation regeneration and ecological recovery across parts of T/A Jenala. Increased vegetation density in some areas suggested partial restoration of farming activities and natural vegetation growth.

Despite these improvements, vegetation conditions have not fully returned to pre-cyclone baseline levels. Several areas continued to display reduced vegetation density and signs of environmental stress, particularly in heavily eroded and flood-prone zones. This indicates that environmental recovery remained incomplete more than two years after Tropical Cyclone Freddy.

The findings therefore classify environmental recovery in T/A Jenala as partial and degraded, demonstrating that the cyclone had long-term impacts on ecological resilience,

vegetation systems, and agricultural sustainability.

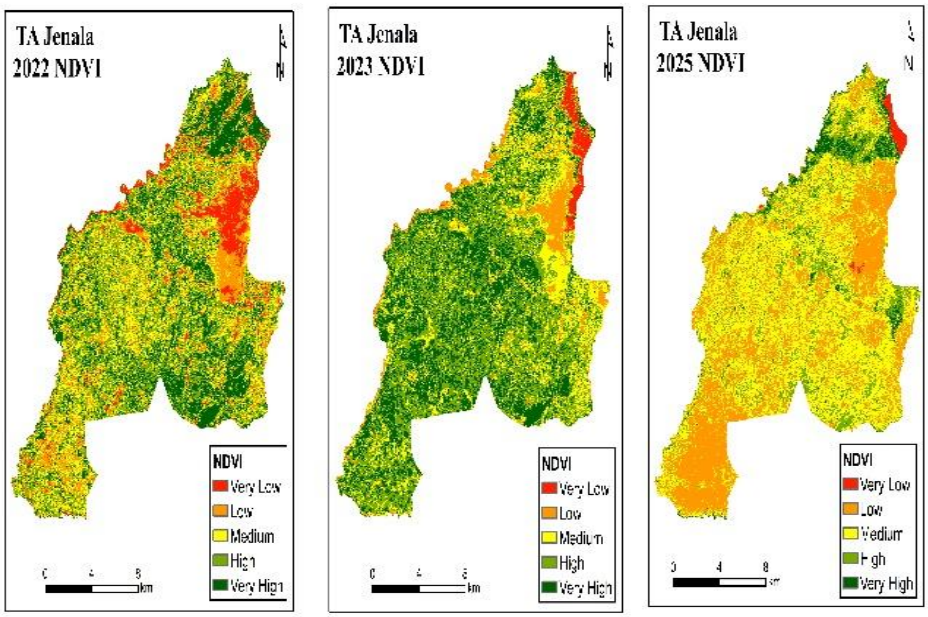


Figure 7: NDVI maps for 2022, 2023 and 2025

The figure above presents NDVI-based vegetation health maps for T/A Jenala across three periods: pre-cyclone conditions (2022), immediate post-cyclone impacts (2023), and long-term recovery trends (2025). The maps illustrate vegetation loss after Tropical Cyclone Freddy and gradual ecological regeneration over time.

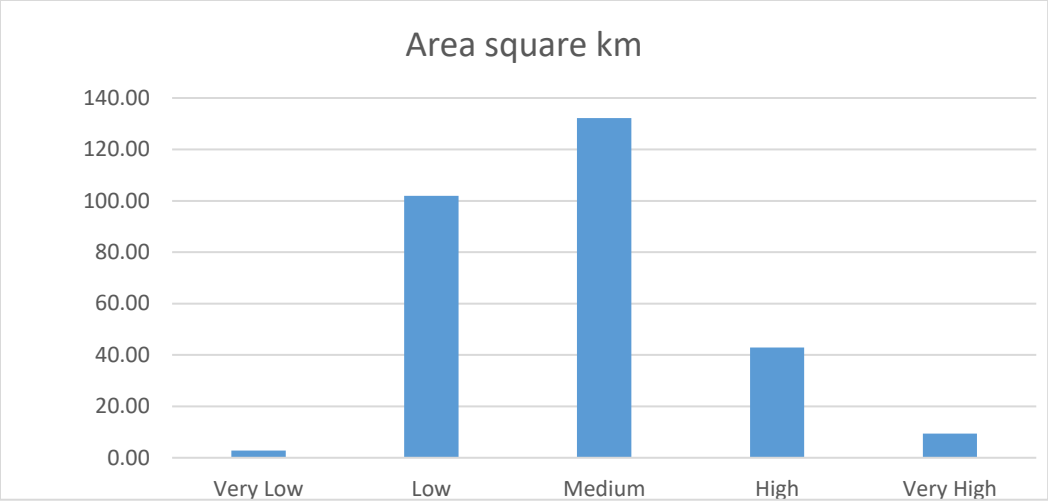


Figure 8 shows vegetation health trends

The graph shows changes in vegetation density and ecological recovery trends between 2022 and 2025. The results indicate a sharp decline in vegetation health immediately after the cyclone followed by gradual but incomplete environmental recovery by 2025.

Overall Environmental Recovery Rating: Degraded / Partial Recovery

The NDVI analysis demonstrates that although environmental recovery has begun, ecological conditions and vegetation health in T/A Jenala remain below pre-cyclone levels. Continued environmental degradation, soil erosion, and incomplete vegetation regeneration indicate persistent ecological vulnerability within the study area.

4.3 Discussion of results

4.32 Social recovery

The findings indicate that social recovery in T/A Jenala has achieved moderate progress more than two years after Tropical Cyclone Freddy. The restoration of education and healthcare services demonstrates important improvements in the normalization of community life following the disaster. All respondents confirmed that children had returned to school despite widespread destruction of educational infrastructure during the cyclone. This finding agrees with studies from government of Malawi (Malawi, Malawi

2015 floods post-disaster needs assessment, 2015) and (UNDRR, 2017), which emphasize that the restoration of essential social services such as schools and healthcare facilities is a critical indicator of post-disaster recovery and community stabilization. Access to education after disasters helps restore routine, reduce child vulnerability, and support psychological recovery among affected households.

The findings from the Focus Group Discussion (FGD) and Key Informant Interviews (KIIs) further revealed that healthcare services had resumed operation in most areas despite some infrastructural limitations. Similar findings were reported after Cyclone Idai in Malawi and Mozambique, where healthcare and education services gradually resumed but continued operating under difficult infrastructural and resource conditions (GFDRR, 2019). According to (Olshansky, 2009), successful social recovery requires not only physical rebuilding but also restoration of critical social systems that support community wellbeing and stability.

The presence of disaster preparedness committees in all surveyed communities also suggests that local disaster governance structures have improved after the cyclone. Community-based disaster risk management committees are widely recognized as important mechanisms for improving preparedness, information sharing, and emergency coordination at local level (UNDRR U. N., 2015). Similar observations were made by (Kayamba-Phiri, 2023), who found that local preparedness committees in Malawi contribute significantly to community awareness and disaster response coordination when adequately supported.

However, the study found that only 50% of households believed evacuation planning had improved after Cyclone Freddy. This suggests that although preparedness structures exist, practical preparedness capacity remains only partially effective. (Trogrlić, 2022) similarly observed that many disaster preparedness initiatives in Malawi remain constrained by weak implementation, inadequate funding, and limited community participation. In many rural communities, evacuation systems are poorly coordinated, and early warning messages are not always translated into effective action due to limited trust, poor communication systems, and lack of evacuation resources.

The findings further reveal that community cohesion and social unity remain fragile more than two years after the disaster. Most respondents described community unity as either weak or only moderately recovered. Participants during the FGD explained that displacement, deaths, destruction of homes, and prolonged economic hardship negatively affected social relationships and weakened social support systems within communities. These findings are consistent with studies by (Kangoma, Mental health impact of the 2023 Tropical Cyclone Freddy.., 2023), who documented significant psychosocial and social impacts of Cyclone Freddy in southern Malawi, including trauma, grief, social stress, and disruption of community networks.

Social cohesion is widely recognized as a key component of resilience and long-term disaster recovery. According to (Folke, 2006), resilient communities are characterized by strong social networks, trust, cooperation, and collective action during and after disasters. Similarly, (Adger, Social capital, collective action, and adaptation to climate change, 2003) argues that social capital and community cohesion play a critical role in helping communities recover from shocks and adapt to future risks. The weakened social unity observed in T/A Jenala therefore suggests that important dimensions of social resilience remain incomplete despite improvements in access to services.

The study also established that psychological support services were available in some areas, but access remained limited and inconsistent, especially among vulnerable groups. Many respondents reported ongoing emotional stress, trauma, fear of future floods, and anxiety associated with cyclone experiences. Similar findings were reported by (Braka F. D., 2024), who observed that Cyclone Freddy caused major mental health and psychosocial challenges among affected populations in Malawi. Disaster-related trauma often persists long after physical reconstruction has taken place, particularly in communities repeatedly exposed to floods and displacement.

The findings further support Resilience Theory, which emphasizes that disaster recovery involves more than rebuilding physical infrastructure. Recovery also requires restoration of psychological wellbeing, social relationships, institutional trust, and adaptive capacity

(Folke, 2006). The continued weakness in community cohesion and psychosocial recovery therefore indicates that social resilience in T/A Jenala remains fragile and incomplete.

In addition, the findings support the "Build Back Better" principle promoted under the Sendai Framework for Disaster Risk Reduction (2015–2030), which encourages countries to use recovery processes as opportunities to strengthen resilience and reduce future vulnerability (UNDRR U. N., 2015). Although the establishment of preparedness committees represents positive progress, gaps in evacuation planning, psychosocial support, and community cohesion indicate that recovery efforts have not yet fully achieved resilient social reconstruction.

Overall, the findings suggest that social recovery in T/A Jenala has been moderate. While significant progress has occurred in restoring schools, healthcare services, and community preparedness structures, important social challenges remain unresolved. Persistent weaknesses in psychosocial support, evacuation preparedness, and community cohesion demonstrate that long-term social resilience is still developing. These findings partially answer the first research objective by showing that social recovery following Tropical Cyclone Freddy has progressed moderately but remains incomplete in several important dimensions of community wellbeing and resilience.

4.32 Economic recovery

The findings indicate that economic recovery in T/A Jenala remains weak and incomplete more than two years after Tropical Cyclone Freddy. The substantial decline in household income, reduced farming productivity, and failure to restore livestock assets demonstrate that many households continue struggling to recover economically from the disaster. The average monthly household income declined from MWK 50,176 before the cyclone to MWK 20,523 after the cyclone, representing a reduction of approximately 56.86%. This sharp decline highlights the severe long-term economic impacts of climate-related disasters on rural livelihoods in Malawi and demonstrates that many households have not regained their pre-disaster economic status.

The findings further show that agriculture remains the most severely affected livelihood sector within the study area. Before the cyclone, approximately 90% of households depended primarily on subsistence farming as their main source of income and food security. However, the destruction of crops, farmland, irrigation systems, and agricultural inputs forced many households to shift toward small informal businesses and casual labor activities that generate significantly lower and unstable incomes. Similar findings were reported by (Hallegatte, 2017), who argued that poor rural households in developing countries recover more slowly from disasters because they depend heavily on climate-sensitive livelihoods such as agriculture and often lack savings, insurance, or diversified income sources that could cushion economic shocks.

Participants in the Focus Group Discussion (FGD) and the District Risk Management Officer (DRMO) interview explained that floodwater washed away crops and destroyed farmland during Cyclone Freddy. In addition, prolonged waterlogging, soil erosion, and sand deposition reduced soil fertility and farming productivity even after floodwaters subsided. Only 20% of households reported improved farming productivity after the cyclone, indicating that agricultural recovery remains limited. These findings are consistent with studies by (MacLeod C. e., 2025), which found that Cyclone Freddy caused severe environmental degradation, destruction of crops, and long-term agricultural productivity challenges in southern Malawi. Environmental degradation therefore continues to undermine livelihood recovery because agriculture remains the backbone of the rural economy in T/A Jenala.

The findings also reveal that many households remain trapped in low-income coping strategies because they lack sufficient financial capital to restart productive economic activities. Participants during the FGD explained that although some households attempted to establish small businesses after losing farmland and crops, most businesses generated very little income due to limited startup capital, weak local markets, and widespread poverty within the community. Similar observations were made by (Dercon, 2004), who argued that disasters frequently push vulnerable households into chronic poverty because

the loss of productive assets limits future income generation and increases dependence on survival-based activities.

The study further established that livestock losses had largely not been replaced. Livestock are important livelihood assets in rural Malawi because they provide food, income, savings, manure, and financial security during periods of crisis. According to the Sustainable Livelihoods Framework developed by Chambers and (Chambers, 1992), disasters often destroy household livelihood assets, making long-term recovery difficult unless external support strengthens productive capacity and resilience. The inability of households in T/A Jenala to replace livestock therefore reflects continuing economic vulnerability and weak recovery capacity.

The findings also suggest that recovery assistance provided after the cyclone was insufficient to support long-term livelihood restoration. Participants in the FGD and KIIs acknowledged that humanitarian assistance such as cash transfers, maize distributions, and seed support helped reduce hunger and immediate suffering during the emergency period. However, respondents explained that most support programs were short-term and did not provide adequate long-term capital investment necessary for sustainable recovery. Similar findings were reported by (UNDRR U. N., 2015), which argues that post-disaster recovery programs often fail when they focus mainly on emergency humanitarian relief without supporting long-term livelihood rebuilding and resilience strengthening.

Studies conducted after Cyclone Idai in southern Africa found that many recovery interventions concentrated on short-term humanitarian assistance while neglecting long-term economic resilience and livelihood diversification (GFDRR, 2019). (GFDRR, 2019) further argue that sustainable disaster recovery requires investment in productive assets, resilient agricultural systems, market access, irrigation infrastructure, and livelihood diversification rather than temporary relief assistance alone.

The findings additionally reveal that lack of access to financial services and credit facilities continues to limit recovery among affected households. Most respondents explained that

they lacked the money needed to purchase farming inputs, rebuild irrigation systems, restock livestock, or invest in income-generating activities. Poor households often face significant barriers to accessing loans or formal financial support after disasters, especially in rural areas where banking and insurance services are limited. According to (World, 2019), financial exclusion significantly slows post-disaster recovery in developing countries because affected households cannot rebuild productive assets or invest in resilient livelihood systems.

The weak economic recovery observed in T/A Jenala also reflects broader structural vulnerabilities within rural Malawi. High dependence on rain-fed agriculture, poverty, environmental degradation, and weak rural infrastructure continue to increase household vulnerability to climate-related disasters. Similar findings were reported by (Braka F. a., 2024), who observed that Cyclone Freddy caused widespread livelihood disruption, food insecurity, and economic instability among affected households in southern Malawi.

The findings further support Resilience Theory and the Sustainable Livelihoods Framework, which emphasize that successful recovery depends on the ability of households to rebuild livelihood assets, strengthen adaptive capacity, and diversify income sources aftershocks (Folke, 2006). The continued decline in farming productivity, limited income opportunities, and dependence on low-income survival strategies indicate that household resilience in T/A Jenala remains weak and fragile.

Furthermore, the results demonstrate that recovery has not fully followed the "Build Back Better" principle promoted under the Sendai Framework for Disaster Risk Reduction (2015–2030), which encourages countries to use recovery processes as opportunities to strengthen resilience and reduce future vulnerability (UNDRR U. N., 2015). The absence of substantial long-term livelihood investment and resilient agricultural support suggests that many households remain highly exposed to future climate shocks.

Overall, the findings confirm that economic recovery in T/A Jenala remains weak, uneven, and incomplete more than two years after Tropical Cyclone Freddy. Most households

continue experiencing reduced income levels, poor farming productivity, and limited livelihood opportunities due to environmental degradation, asset loss, and lack of long-term capital support. These findings answer the second research objective and support the study problem that many affected households have not fully recovered economically and remain highly vulnerable to future climate-related disasters.

4.33 infrastructural recovery

The findings of this study indicate that infrastructural recovery in Traditional Authority (T/A) Jenala remained incomplete, uneven, and only partially resilient more than two years after Tropical Cyclone Freddy. Although reconstruction efforts had restored some essential services and physical structures, many households and critical public infrastructures continued to face significant vulnerabilities. These findings are consistent with broader disaster recovery literature which argues that post-disaster reconstruction in developing countries is often prolonged, fragmented, and constrained by poverty, weak institutional capacity, and inadequate financial resources (GFDRR, 2019); (UNDRR, 2017).

The study revealed that while 60% of households had rebuilt permanent houses, many structures remained weak or semi-permanent, while 40% of households were either still living in temporary shelters or had not fully reconstructed their homes. This demonstrates that housing recovery remains one of the slowest dimensions of post-disaster recovery in rural Malawi. Similar findings were reported following Cyclone Idai in Malawi and Mozambique, where affected households struggled to rebuild durable homes due to limited access to capital, rising construction costs, and insufficient long-term support (World, 2019). (Hallegatte, 2017) explains that poor households often recover slowly after disasters because they lack savings, insurance, and diversified income sources, forcing them to reconstruct using weak materials that increase vulnerability to future hazards.

The persistence of temporary shelters and structurally weak housing in T/A Jenala further suggests limited implementation of the “Build Back Better” (BBB) principle promoted under the Sendai Framework for Disaster Risk Reduction (UNDRR U. N., 2015). The BBB concept

advocates reconstruction processes that improve pre-disaster conditions through safer housing standards, resilient infrastructure, and risk-sensitive land-use planning (Clinton, 2006). However, the findings of this study indicate that reconstruction in many parts of T/A Jenala prioritized immediate shelter needs over long-term resilience. Similar observations were made by (Fernandez, 2019), who argue that recovery programs in many developing countries focus on rapid rebuilding rather than transformational recovery capable of reducing future disaster risks.

The study also established that roads and bridges remained highly vulnerable and difficult to use during rainy seasons. Transport infrastructure plays a critical role in recovery because it supports mobility, access to healthcare, market participation, education, and disaster response. Poor road conditions in T/A Jenala continue to limit economic recovery and increase isolation during flood periods. These findings support (Der Sarkissian, 2023), who found that weak transport infrastructure significantly delays long-term recovery and undermines resilience in disaster-prone communities. Similarly, (Manda S. &., 2025) observed that damaged roads and bridges after Cyclone Freddy disrupted humanitarian operations, delayed service delivery, and worsened economic hardships in southern Malawi.

The findings further revealed that schools and most health facilities had resumed operation, although some facilities remained partially damaged. The restoration of education and healthcare services represents an important step toward community normalization after disasters. According to (Olshansky, 2009), recovery of social infrastructure such as schools and health centers contributes significantly to psychological stability, social cohesion, and restoration of livelihoods. However, the continued partial functionality of some facilities in T/A Jenala indicates uneven infrastructural recovery across sectors. (Braka F. D., 2024) similarly found that Cyclone Freddy severely disrupted public service delivery systems in southern Malawi and that many facilities struggled to fully recover due to resource limitations and infrastructure damage.

Access to clean water had improved considerably, with approximately 70–80% of households reporting access to safe water sources. This reflects positive progress in restoring essential community services after the disaster. However, irrigation systems and flood protection structures such as dikes have remained damaged or incomplete, exposing communities to future agricultural and flood risks. These findings are significant because agriculture is the dominant livelihood activity in T/A Jenala, and damaged irrigation infrastructure directly threatens food production and economic recovery. (MacLeod C. e., 2025) argue that environmental degradation and destruction of agricultural infrastructure after climate-related disasters reduce household resilience and prolong livelihood insecurity in rural communities.

The GIS and satellite image analysis strengthened these findings by showing substantial environmental and infrastructural changes between the pre-cyclone and post-cyclone periods. The 2023 imagery revealed flooding, vegetation loss, erosion, and changes in settlement patterns, while the 2025 analysis showed gradual reconstruction and environmental recovery. However, the study found that some households rebuilt within flood-prone areas despite the known risks. This suggests weak enforcement of land-use planning policies and inadequate integration of disaster risk reduction principles into recovery planning. (Wisner, 2004)argue that vulnerability is socially produced when populations continue settling in unsafe environments due to poverty, limited alternatives, and weak governance systems. Similar patterns have been documented in Bangladesh, Mozambique, and other flood-prone regions where communities rebuild repeatedly in hazardous locations because of livelihood dependence and social attachment to land (Adger, Social capital, collective action, and adaptation to climate change, 2003).

The findings also demonstrate that infrastructural recovery in T/A Jenala remains highly dependent on external humanitarian and government support. FGDs and KIIs revealed that many reconstruction projects were delayed due to inadequate funding and weak coordination among stakeholders. (Trogrlić, 2022) similarly found that disaster recovery programs in Malawi often face coordination challenges between government institutions, NGOs, and local communities, reducing the effectiveness and sustainability of recovery

interventions. (Hofmann, 2022) further argue that successful recovery requires long-term investment, institutional coordination, and integration of resilience measures into reconstruction processes rather than short-term project-based interventions.

From a theoretical perspective, the findings strongly support Resilience Theory, which emphasizes that recovery should strengthen the capacity of communities and systems to absorb, adapt to, and recover from future shocks (Folke, 2006). In T/A Jenala, some essential infrastructures have been restored, but long-term resilience remains limited because many reconstructed systems remain vulnerable to future floods and climate-related hazards. The continued existence of weak housing, damaged roads, incomplete irrigation schemes, and rebuilding in high-risk zones demonstrates that infrastructural recovery has not yet achieved sustainable resilience.

Overall, the findings suggest that infrastructural recovery in T/A Jenala has been characterized more by partial reconstruction than by resilient transformation. While important progress has been made in restoring schools, healthcare services, water access, and some housing infrastructure, major gaps remain in transport infrastructure, housing resilience, irrigation systems, and flood protection measures. The study therefore confirms that post-disaster recovery following Tropical Cyclone Freddy has not fully achieved "Build Back Better" objectives, leaving communities highly vulnerable to future disasters and climate-related shocks.

4.34 Environmental recovery

The findings of this study indicate that environmental recovery in Traditional Authority (T/A) Jenala remained incomplete more than two years after Tropical Cyclone Freddy. Although some ecological regeneration and vegetation recovery had occurred by 2025, NDVI analysis showed that vegetation health and environmental conditions had not fully returned to pre-cyclone baseline levels. The results demonstrate that Tropical Cyclone Freddy caused long-term environmental degradation that continues to affect ecological resilience, agricultural productivity, and community livelihoods within the study area.

The 2022 baseline NDVI analysis showed that T/A Jenala previously had relatively healthy vegetation cover and stable ecological conditions before the cyclone. Areas characterized by high and very high vegetation density dominated much of the landscape, reflecting active agricultural production and healthy natural vegetation systems. However, the 2023 post-cyclone NDVI results revealed substantial vegetation loss, exposed bare surfaces, soil erosion, and destruction of cultivated land. These findings confirm that Tropical Cyclone Freddy had severe environmental impacts across the district. Similar environmental effects were documented after Cyclone Idai in Malawi and Mozambique, where flooding and landslides caused widespread destruction of vegetation, farmland, forests, and river ecosystems (GFDRR, 2019).

The environmental degradation observed in this study can largely be attributed to flooding, river overflow, sediment deposition, erosion, and destruction of crops and natural vegetation caused by the cyclone. According to the Intergovernmental Panel on Climate Change (IPCC I. P., 2022), climate-related disasters such as tropical cyclones increasingly contribute to ecosystem degradation, loss of biodiversity, declining vegetation cover, and reduced agricultural productivity, particularly in vulnerable developing countries. The findings from T/A Jenala therefore reflect broader global concerns regarding the environmental consequences of climate-induced disasters.

The gradual vegetation regeneration observed in the 2025 NDVI analysis suggests that some ecological recovery and restoration of farming activities have taken place over time. However, the persistence of degraded vegetation conditions in several areas indicates that recovery remains partial and uneven. These findings are consistent with studies by (MacLeod C. e., 2025), which found that environmental recovery after Cyclone Freddy in southern Malawi remained slow due to continued soil degradation, sediment accumulation, and damage to agricultural land and water systems.

The incomplete recovery of vegetation cover also has important implications for local livelihoods because most households in T/A Jenala depend heavily on subsistence agriculture. Environmental degradation directly affects farming productivity, food security,

and household income. The findings support research by (Hallegatte, 2017), which argues that environmental shocks disproportionately affect poor rural households because they rely heavily on natural resources and agriculture for survival. When vegetation systems, soil quality, and water infrastructure are damaged, household recovery becomes more difficult and prolonged.

The study further suggests that environmental degradation and infrastructural damage are closely interconnected. Damaged irrigation schemes, destroyed riverbanks, poor drainage systems, and deforestation contribute to continued environmental instability and increase future flood risks. Similar findings were reported by (Wisner, 2004), who argue that environmental vulnerability is often socially produced through poor land management, settlement in hazard-prone areas, deforestation, and weak environmental governance systems. In T/A Jenala, the destruction of vegetation and continued rebuilding in vulnerable flood-prone areas indicate that long-term environmental resilience remains weak.

The NDVI findings also highlight the importance of integrating environmental rehabilitation into disaster recovery planning. Although humanitarian recovery programs often focus primarily on housing, food aid, and infrastructure reconstruction, environmental restoration is equally important for sustainable recovery and resilience building. According to (UNDRR U. N., 2015), disaster recovery should include ecosystem restoration, sustainable land management, watershed protection, and climate adaptation measures to reduce future disaster risks. However, the findings of this study suggest that environmental rehabilitation in T/A Jenala has received limited long-term investment compared to immediate humanitarian response activities.

The observed environmental degradation also supports Resilience Theory, which emphasizes the ability of ecological and social systems to absorb shocks, adapt, and recover while maintaining essential functions (Folke, 2006). In this study, the environmental system in T/A Jenala experienced significant disruption after Tropical Cyclone Freddy, and although recovery processes have started, ecological resilience remains limited. The

persistence of reduced vegetation density, soil erosion, and degraded farming land demonstrates that the environment has not yet fully regained its pre-disaster stability and productivity.

Furthermore, the use of NDVI and GIS analysis strengthened the reliability of the findings by providing objective spatial evidence of environmental changes over time. Unlike household perceptions alone, satellite imagery clearly demonstrated the extent of vegetation decline after the cyclone and the gradual but incomplete recovery process by 2025. Similar studies by (Der Sarkissian, 2023) and (UNDRR, 2017) emphasize the importance of geospatial technologies in monitoring environmental recovery, land degradation, and climate resilience following disasters.

Overall, the findings suggest that environmental recovery in T/A Jenala remains degraded and incomplete despite gradual vegetation regeneration. Tropical Cyclone Freddy caused significant long-term ecological damage that continues to affect agricultural productivity, environmental stability, and community livelihoods. Although some recovery has occurred, the study demonstrates that stronger environmental rehabilitation programs, sustainable land management practices, reforestation initiatives, and climate-resilient agricultural systems are necessary to improve long-term ecological resilience and reduce future disaster vulnerability in Phalombe District.

5.CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This study set out to assess community recovery and resilience in Phalombe District following Tropical Cyclone Freddy in March 2023. Using a mixed-methods approach with 30 purposively selected households in Traditional Authority Jenala, focus group discussions, key informant interviews, and GIS analysis, the research examined social, economic, infrastructural, and environmental dimensions of recovery more than two years after the disaster.

The study achieved its main objective and specific objectives to a large extent. Key findings show that recovery has been partial and uneven. Social recovery recorded good progress in restoring access to education and basic health services, with 100% of households reporting that children are now attending school and disaster preparedness committees are in place. However, community unity remains weaker than before the cyclone, and psychological support is still limited.

Economic recovery was the weakest area. Average monthly household income dropped by 47.45% (from MWK 46,100 before the cyclone to MWK 24,590 currently). Farming productivity remains low for most households due to soil erosion and lack of capital. Infrastructural recovery is also limited, with only about 60% of sampled households living in permanent houses and many roads and bridges are still difficult to use during the rainy season. GIS analysis revealed environmental degradation.

Overall, while short-term humanitarian assistance effectively addressed immediate survival needs, long-term "build back better" principles have not been fully achieved. Communities in Phalombe District remain highly vulnerable to future climate-related disasters. These findings confirm the problem statement and provide new understanding that recovery efforts in rural Malawi need to move beyond short-term relief toward more sustainable and resilient approaches.

The significance of this study lies in its combination of official DCPC (2023) statistics with primary grassroots data and geospatial evidence. The results offer practical, evidence-based

insights for policymakers, government agencies, NGOs, and development partners working in flood-prone areas of Malawi and southern Africa.

5.2 Study Limitations and Mitigation

The main limitation of this study is the use of purposive sampling, which means the findings cannot be statistically generalized to the entire Phalombe District. Another possible limitation is recalling bias, as respondents were asked to remember conditions before the cyclone (more than two years earlier).

These limitations were addressed by: increasing the sample size to 30 households, combining primary data with official district-wide statistics from the DCPC (2023) report, using multiple data collection methods (questionnaires, FGD, KIIs, and GIS) for triangulation, and focusing on one of the most severely affected areas (T/A Jenala) to provide rich, in-depth information. These steps significantly improved the reliability and credibility of the results.

5.3 Recommendations

Based on the findings, the following recommendations are made:

1. Livelihood Support: Government and development partners should scale up long-term livelihood programs, including provision of loans, treadle pumps, quality seeds, and fertilizer to help households restart farming and small businesses.
2. Resilient Infrastructure: Priority should be given to rebuilding houses to resilient standards and repairing roads, bridges, and dykes to reduce future vulnerability during rainy seasons.
3. Community Preparedness: Disaster preparedness committees should be strengthened with regular training, improved early warning systems, and better evacuation planning that reaches all households.
4. Coordination and "Build Back Better": There is need for better coordination between government, NGOs, and communities to ensure recovery programs focus on long-term resilience rather than only short-term relief.

5. Environmental Rehabilitation: Tree planting and soil conservation programs should be expanded to reverse vegetation loss and reduce soil erosion in affected areas.
6. Address the underlying factors needs of the affected community
7. Shift from reactive relief to proactive resilience

5.4 Policy and action

1. Reforestation: Prioritize native species restoration to stabilize slopes and prevent mudslides
2. Soil conservation: Introduce contour farming and vetiver grass to protect the remaining productive topsoil
3. Livelihood diversification: Support non biomass income to reduce the pressure on local forests for charcoal production.
4. Early warning systems: Invest in localized monitoring to predict secondary environmental shocks post cyclone.

5.5 Suggestions for Future Research

Future studies should use larger, randomly selected samples across multiple Traditional Authorities in Phalombe District or other districts affected by Cyclone Freddy. Longitudinal research that tracks recovery over five or more years would provide deeper insights into long-term resilience building. Studies that include quantitative measurement of psychological wellbeing and economic modelling of livelihood recovery would also be valuable.

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ANNEX

ANNEX 1: Key Informant Questionnaire 1

KEY INFORMANT INTERVIEW

ASSESSING POST DISASTER RECOVERY IN PHALOMBE DISTRICT: LESSON FROM TROPICAL CYCLONE FREDDY

POSITION:

DATE:

SECTION A: IMPACTS OF CYCLONE FREDDY

1. What were the major social impacts of cyclone Freddy on households and vulnerable groups?

Section B: short-term humanitarian interventions

2. What social interventions were provided during and after the cyclone?

3. How effective were these interventions in meeting immediate social needs? What worked well and what did not?

SECTION C: RECOVERY AND RESILIENCE

1. What long-term social recovery programs have your office implemented or supported in the affected villages?
2. To what extent have these programs helped vulnerable households rebuild their livelihoods and social networks?
3. How well were social protection programs linked with other sectors (education, health, livelihoods) during the recovery process?

SECTION D: COPING STRATEGIES AND ADAPTIVE CAPACITY

1. What coping strategies did households, especially vulnerable groups, adopt after the cyclone?

2. Which group recovered faster socially? Why?

3. How effective were the community based social structures (women's groups, village disaster risk management committees?

SECTION D: GAPS AND RECOMMENDATIONS

1. What are the main gaps between short-term humanitarian aid and long-term resilience building in phalombe?
2. What recommendations would young give to improve social recovery and resilience for future cyclones?
3. Is there data or evidence showing whether households with stronger or diversified livelihoods recovered faster than others?

ANNEX 2: **KEY INFRMANT QUESTINNAIRE 2**

KEY INFORMANT INTERVIEW

ASSESSING POST DISASTER RECOVERY IN PHALOMBE DISTRICT T/A JENALA: LESSON FROM TROPICAL CYCLONE FREDDY

POSITION

DATE

SECTION A: IMPACTS OF CYCLONE FREDDY

1. What were the major impacts of cyclone Freddy on housing, public infrastructure and land?

2. What were your main responsibilities regarding land use, housing and infrastructure in disaster contexts?

SECTION B: RECOVERY AND RECONSTRUCTION

3. What infrastructural rehabilitation and reconstruction works has your department carried out after the cyclone?
4. Were "build back better" approaches (resilient housing designs from UNDP or other partners) applied? How effective have they been during recent cyclones?
5. What challenges did you face in reconstructing or repairing infrastructure after the cyclone?

SECTION C: LAND USE AND SPATIAL PLANNING

6. How has allocation and settlement planning been managed in flood prone and landslide prone areas?

7. Are there any restrictions or relocation plans for villages in high-risk zones?
8. What does your office do in regulating construction in risk prone areas?

SECTION D: RESILIENCE

1. To what extent are disaster risk considerations integrated into your department's routine land and infrastructure planning?
2. How well coordinated the work between your department, the social and DODMA and NGOs during the recovery period?

SECTION E: GAPS AND RECOMMENDATIONS

1. What were the biggest gaps in infrastructure recovery and land management that continue to leave the communities vulnerable to future disasters?
2. What specific recommendations would you make to strengthen infrastructural resilience and sustainable land use in Phalombe?

3. In your view, which communities or household types recovered their housing and productive assets faster and why?

ANNEX 3: INDIVIDUAL QUESTIONNAIRE

INDIVIDUAL HOUSEHOLD QUESTIONNAIRE

A. Household demographic information

Gender:

Male

Female

Age

Educational level

Total household members

Number of household members with disability

B. DISASTER IMPACT

1. What was the water level at your house during the cyclone?
   Ankle
   Knee
   Waist
   Above chest
   House fully submerged
2. How long does water remain around your home?
3. Was your house damaged?
   Not damaged
   Partially damaged
   Completely damaged
4. Type of house before the cyclone
   Mud

Burnt bricks

Cement blocks

5. Did you household lose

Crops

Livestock

Household property

Others

C. EVACUATION AND EARLY WARNING

1. Did you receive warning before flooding?

Yes

No

2. Source of warning

Radio

Phone message

Community leaders

Neighbors

Others

3. Was the warning clear?

Very clear

Clear

Not clear

No warning received

4. Did your household evacuate?

Yes

No

5. If yes, when?

Before flooding

During flooding

After damage occurred

6. Where did you evacuate to?

   Evacuation center

   School

   Church

   Relative house

   Other

7. If you did not evacuate, why?

   No safe place

   Did not expect severe flooding

   Protecting property

   No transport

   Other

8. Were the basic services available at the evacuation site?

   Food

   Water

   Toilets

   Health services

   None

9. Did you feel safe at the evacuation site?

   Yes

   No

10. Did evacuation reduce your losses?

D. SOCIAL, ECONOMIC AND INFRASTRUCTURE RECOVERY

1. Are children currently attending school?

Yes

No

2. Was the nearest school damaged?

Yes

No

3. Is the nearest health facility functional?
   Full functional
   Partially functional
   Not functional
4. Do you currently have access to clean water?
   Yes
   No
5. Time taken to fetch water
6. The community supported each other after the cyclone:
   Strongly agree
   Agree
   Neutral
   Disagree
   Strongly disagree
7. Main livelihood before cyclone
   Farming
   Small business
   Casual labor
   Formal employment
   Other
8. Current livelihood status
   Same as before
   Changed
   No income source
9. Crop production compared to before
   Fully recovered
   Partially recovered
   Not recovered
10. Monthly income before cyclone (mwk)

11. Current monthly income(mwk)
12. Livestock status

    Fully replaced

    Partially replaced

    Not recovered
13. Current house condition

    Permanent rebuilt

    Temporary shelter

    Not rebuilt
14. Road access to village

    Fully accessible

    Difficult in rainy season

    Not accessible
15. Bridges

    Repaired

    Not repaired

E. ASSISTANCE AND SUPPORT

1. Did your household receive assistance?

   Yes

   No
2. Source

   Government

   NGO

   Community

   Religious institutions

   Other
3. Type of assistance

   Food

   Cash

   Shelter materials

Farming inputs

Medical support

F. RATING RECOVERY

1. How would you rate overall recovery?

   Very weak

   Weak

   Moderate

   Strong

   Very strong

2. Is there disaster preparedness committee?

   Yes

   No

3. Has evacuation planning improved since the cyclone?

ANNEX 4: **FOCUS GROUP DISCUSSION**

FOCUS GROUP DISCUSSION GUIDE

a) SOCIAL RECOVERY QUESTIONS

1. How did cyclone Freddy affect your community socially?
2. How did families cope immediately after the disaster?
3. Have schools and health services fully recovered?
4. Has community unity increased or decreased after the disaster?

b) ECONOMIC RECOVERY DISCUSSION QUESTIONS

1. What were the main livelihoods before the cyclone?
2. Which livelihoods were mostly affected?
3. Have farmers or business fully recovered?

4. What support helped most in economic recovery?
5. What economic challenges still exist?

c) INFRASTRUCTURE RECOVERY QUESTIONS

1. What infrastructure was most damaged?
2. Have roads, bridges and houses been repaired?
3. Are reconstruction efforts adequate?
4. What infrastructure gaps remain?

d) COMMUNITY RESILIENCE

1. Is the community better prepared for future disasters?
2. What local coping strategies exist?
3. What should government improve?