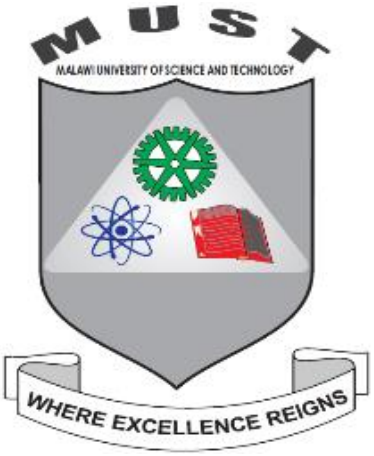


EVALUATION OF THE EFFECTIVENESS OF THE RADIO-BASED FLOOD WARNINGS FOR VISUALLY IMPAIRED INDIVIDUALS IN T/A NGABU, CHIKWAWA

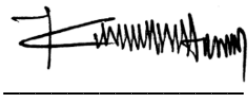
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Dissertation submitted to Ndata school of climate and earth sciences of the Malawi university of science and technology in partial fulfilment of the requirements for the bachelor of science degree in disaster risk management.

MAY, 2025

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Declaration

I Ashley Duwe, declare that this research project represents mt own work and that it has never been submitted to this institution or any other institution for any academic purpose. All sources of information have been appropriately acknowledged

ASHLEY DUWE SIGNATURE.....

DISCLAIMER

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TABLE OF CONTENTS

Abstract XIII
Acknowledgements V
ACRONYMS/ABBREVIATIONS IX
CHAPTER 1.0. INTRODUCTION 1
1.1. BACKGROUND 1
1.2. Problem Statement 3
1.3. MAIN AND SPECIFIC OBJECTIVES 5
1.3.1. Main Objective 5
1.3.2. Specific Objectives 5
1.4. Research Questions 6
1.5 Significance of the Study 6
CHAPTER 2.0: LITERATURE REVIEW 9
2.1 INTRODUCTION 9
2.2 CHALLENGES IN UNDERSTANDING AND RESPONDING TO RADIO FLOOD WARNINGS 9
2.2.1 Health Belief Model and Response Motivation 9
2.2.2 Barriers to Effective Response 10
2.3 THEORETICAL FRAMEWORKS IN DISASTER COMMUNICATION AND DISABILITY INCLUSION 11
2.3.1 Media Dependency Theory in Disaster Contexts 11
2.3.2 Social Model of Disability and Disaster Communication 12
2.3.3 Information Processing Theory and Audio Communication 14
2.3.4 Crisis Communication Theory and Vulnerable Populations 15
2.4 HISTORICAL CONTEXT OF INCLUSIVE DISASTER RISK REDUCTION 16
2.4.1 Evolution of Disability Inclusion in Global DRR Frameworks 16
2.4.2 Development of Radio-Based Warning Systems in Malawi 17
2.5 ACCESSIBILITY OF RADIO FOR VISUALLY IMPAIRED INDIVIDUALS 18
2.5.1 Technological Adaptations and Challenges 18
2.5.2 Community-Based Solutions and Social Support Networks 19
2.6 CLARITY AND COMPREHENSION OF RADIO-BASED FLOOD WARNINGS 21

2.6.1 Communication Accommodation Theory and Message Design 21
2.6.2 Linguistic Accessibility and Cognitive Load 22
2.7 ENHANCING RADIO FLOOD WARNINGS: PARTICIPATORY APPROACHES 23
2.7.1 Participatory Communication Theory and Inclusive Design 23
2.7.2 Co-creation of Accessible Warning Systems 24
2.8 GLOBAL BEST PRACTICES IN INCLUSIVE FLOOD WARNING SYSTEMS . 25
2.8.1 Case Studies from Bangladesh: Community Radio Initiatives 25
CHAPTER 3.0. RESEARCH METHODOLOGY 27
3.1 Study Design 27
3.2 Study Area 27
3.3 Site Selection 28
3.4 Target Population 29
3.5 Sampling and Sample Size 29
3.5.1 Sampling Techniques 29
3.5.2 Sample Size 29
3.6 Data Collection Methods 31
3.6.1 Quantitative Data Collection 31
3.6.2 Qualitative Data Collection 31
3.6.3 Social Network Data Collection 31
3.7 Data Analysis 32
3.7.1 Quantitative Analysis 32
3.7.2 Qualitative Analysis 32
3.7.3 Social Network Analysis 32
3.7.4 Data Integration and Triangulation 33
CHAPTER 4: RESULTS AND DISCUSSION 34
4.1 Introduction 34
4.2 RESULTS OF THE STUDY 34
4.2. 1 Demographic Profile of Respondents 34
4.2.1.1 Visually Impaired Respondents 34
4.2.1.2 Radio Station Representatives and Community Members 35
4.2.2 Radio Access Among Visually Impaired Individuals 36

4.2.2.1 Radio Ownership and Access Patterns 36
4.2.2.2 Barriers to Radio Access 37
4.2.3.1 Comprehension Levels and Broadcasting Parameters..... 39
4.2.3.2 Factors Affecting Warning Comprehension 40
4.2.4 Response to Radio-Based Flood Warnings 42
4.2.4.1 Reported Actions Following Warnings 42
4.2.4.2 Timeliness of Warning Receipt and Response..... 43
4.2.5 Institutional Arrangements and Radio Station Practices..... 44
4.2.5.1 Current Broadcasting Practices 44
4.2.5.2 Preferred Radio Stations for Flood Warnings 45
4.2.5.3 Institutional Coordination and Capacity 46
4.2.6 Community Support Systems and Social Networks..... 47
4.2.6.1 Informal Support Mechanisms..... 47
4.2.6.2 Social Network Analysis of Information Flow 48
4.2.7 Recommendations for System Improvement..... 50
4.2.7.1 Stakeholder Recommendations 50
4.2.7.2 Multivariate Analysis of Recommendation Priorities.....51
4.3 Discussion of the Results 52
4.3.1 Radio Access Among Visually Impaired Individuals 52
4.3.2 Understanding of Flood Warning Messages 53
4.3.3 Response to Radio-Based Flood Warnings 55
4.3.4 Institutional Arrangements and Radio Station Practices..... 55
4.3.5 Community Support Systems and Social Networks..... 57
4.3.6 Recommendations for System Improvement..... 58
4.3.7 Theoretical Implications..... 59
4.3.8 Practical Implications 61
Chapter 5: Conclusion and Recommendation..... 62
5.2 Conclusion 63
5.3 Study Limitations and Future Research Directions..... 64
5.4 Recommendations..... 65
5.4.1 Technical Improvements..... 66
5.4.2 Institutional Arrangements 66

5.4.3 Community Support Systems 67
5.4.4 Policy and Resource Mobilization 67
CHAPTER 6: Ethical Considerations 68
REFERENCES 69
APPENDICES 77

ACRONYMS/ABBREVIATIONS

EWS	Early Warning Systems
DRR	Disaster Risk Reduction
T/A	Traditional Authority
DoDMA	Department of Disaster Management Affairs
UNDRR	United Nations Office for Disaster Risk Reduction
WHO	World Health Organization
NSO	National Statistics Office
CRPD	Convention on the Rights of Persons with Disabilities
MACOHA	Malawi Council for the Handicapped
UN	United Nations
BNNRC	Bangladesh NGOs Network for Radio and Communication
SMS	Short Message Service
NGOs	Non-Governmental Organizations
DRM	Disaster Risk Management
FGDs	Focus Group Discussions
SPSS	Statistical Package for Social Sciences
ANOVA	Analysis of Variance
MBC	Malawi Broadcasting Corporation
NSO	National Statistical Office
km^2	Square kilometers (unit of measurement)
SD	Standard Deviation
χ^2	Chi-square statistical test
OR	Odds Ratio
CI	Confidence Interval
KMO	Kaiser-Meyer-Olkin
WHO	World Health Organization
M	Mean
η^2	Eta squared
VI	Visually Impaired
CM	Community Member

LIST OF FIGURES

Figure 1:Map Showing Study Area 28
Figure 2: Mixed methods flow 33
Figure 3: Barriers to Radio Access Among Visually Impaired Individuals 38
Figure 4: Reported Actions Fpllowing Radio-Based Flood Warnings 43
Figure 5: Institutional coordination 47
Figure 4: Institutional Relationships in Early Warning System.....60
Figure 5: Community Information Flow Network.....62

LIST OF TABLES

Table 1: Demographic Profile of Visually Impaired Respondents (n=30)..... 34
Table 2: Demographic Profile of Community Respondents (n=50) 35
Table 3: Radio Ownership and Access Among Visually Impaired Respondents (n=30)..... 36
Table 4: Comprehension of Radio Flood Warnings Among Visually Impaired Respondents (n=30) 39
Table 5: Factor Analysis of Warning Comprehension Barriers (n=30)..... 40
Table 6: Radio Station Flood Warning Broadcasting Practices (n=6) 44
Table 7: Preferred Radio Stations for Flood Warnings (n=30)..... 45
Table 8: Stakeholder Recommendations for System Improvement (Multiple Response)..... 50

ABSTRACT

This study evaluates the effectiveness of radio-based flood warning systems for visually impaired individuals in Traditional Authority Ngabu, Chikwawa District, Malawi. While radio is widely used for emergency communication, its design and implementation often exclude the needs of visually impaired populations. Using a convergent parallel mixed-methods design, the research integrates survey data, interviews, focus groups, and social network analysis to examine radio access, message comprehension, response actions, and institutional dynamics.

Findings reveal significant disparities: only 40% of visually impaired respondents owned radios, with completely blind individuals significantly underrepresented (25%) compared to partially blind (50%). Economic status emerged as a strong predictor of ownership (OR=3.25, $p=0.005$). Barriers such as battery affordability (73.3%), difficulty in radio operation (91.7% among completely blind), and poor signal reception during storms were prevalent. Only 32.1% fully understood radio warnings, with comprehension highly influenced by language ($p=0.022$) and education level ($\eta^2=0.29$). Response delays were notable, with visually impaired individuals facing an average of 2.3 additional transmission steps ($p<0.001$), adding 15–30 minutes of delay per step.

Social network analysis showed visually impaired individuals occupied peripheral communication roles (eigenvector centrality = 0.14 *vs.* 0.42, $p<0.001$), and institutional analysis revealed minimal integration between disaster management offices and disability organizations. Community support was largely informal and proximity-based, with social isolation correlating with significantly delayed warning reception ($p<0.001$).

CHAPTER 1.0. INTRODUCTION

BACKGROUND

Flood risks are worsening due to climate change throughout sub-Saharan Africa, putting Malawi's lower-lying regions like Chikwawa District at risk of more frequent and serious flooding. Specifically in T/A Ngabu, the average large-scale flooding has risen by 37% over the last decade, peaking at 3-4 major flooding events a year from 2020 to 2024, with the most recent data showing a recorded average from 2020-2024 (DoDMA, 2023). Approximately 65% of residents within this region are affected by these events, particularly disadvantaged groups bear the brunt of the impacts.

There is a great lack of information on how EWS (Early Warning Systems) are designed for rural flood-prone communities with sight loss. The Malawi National Census states that in 2022 approximately 2.4% of the population was visually impaired, while T/A Ngabu's rural setting contributes to the higher ratio of 3.2% in more remote areas. This equates to an estimated 5,050 people who are sight-impaired and more vulnerable during floods, yet little has been done on providing warning systems tailored for them.

The Social Model of Disability (Oliver, 1996) helps to analyze this issue in which societal barriers rather than the impairments themselves form disability. In terms of disaster communication, the lack of accessible warnings is a socially created impediment that prevents the full participation of people with visual disabilities in disaster preparedness and response.

EWS are essential components of Disaster Risk Reduction (DRR), providing timely alerts that enable communities to safeguard themselves and prevent losses (Basha et al., 2021). The Media Dependency Theory (Ball-Rokeach & DeFleur, 1976) claims that dependence on mass media increases during crises when other informational avenues are not available. This dependency is especially acute for visually impaired people as warning systems are not only unhelpful; they are out of reach, rendering radio their sole means of obtaining information during disasters.

In rural areas such as T/A Ngabu, radio is the most useful warning tool, with about 78% of internet access compared to 23% and television ownership at 18% (Malawi Communications Authority, 2024). However, most locally available radios do not have technological aids such as tactile buttons or voice interfaces which are prevalent in most high-income countries.

Effective warning radio systems for the visually impaired exist internationally. For instance, in Bangladesh, community radios broadcast flood warnings for people with disabilities that visually impaired individuals can use to prepare to evacuate (Khan et al. 2019). Also, more recent projects from Mozambique (2022-2023) combine local knowledge with scientific predictions, using local languages to repeat information specifically designed for visually impaired audiences (Mozambique Disaster Management Institute 2023).

Just like that, during the floods that affected the northern Philippines in 2022, radio stations practiced a "disability-inclusive broadcasting protocol" where they used specific warning sounds and simplified language tailored for the non-sighted audience (Philippines Disaster Risk Reduction Management Council, 2023). These examples, albeit from different contexts, show that radio warnings can serve visually impaired individuals if designed and implemented properly.

While the national disaster management policies in Malawi are inclusive and address the needs of the visually impaired in the framework set out in 2021, they do not provide specific details on how this gap would be addressed. This creates a notable policy gap contrasting with other provisions on inclusive disaster risk reduction, such as the Sendai Framework for Disaster Risk Reduction 2015-2030, which clearly articulates the need for disability-inclusive provisions and strategies in disaster risk management (UNDRR, 2020).

As research points out, visually impaired individuals respond better to put forth repetitive warnings that are given in slow speech and contextually elaborate (Bali et al., 2018). In the absence of such accommodations, visually impaired individuals underestimate potential threats and do not engage in the appropriate forward-looking actions (Levac et al., 2012).

In T/A Ngabu, traditional methods of tracking time, such as monitoring animal activities and shifts in the wind, aid but do not substitute for the need for radio warnings due to climate change (Chikwawa District Environmental Office, 2023).

Amid growing climate-driven flood hazards, understanding how radio warnings, serving as the main source of information for blind individuals in remote locations of Malawi, can be improved possesses significant value. This study endeavors to assess the effectiveness of radio-based flood alert systems for the blind in T/A Ngabu, examine the gap in response advocacy, perception, and propose practical recommendations to enhance responsiveness in warning systems. Aimed results will enhance the strategies for managing disaster risks and ensure the right information is delivered in for visually impaired citizens of Malawi.

Problem Statement

Flooding occurs as one of the most frequent, severe, and devastating natural occurrences within Malawi, resulting in large scale displacement, loss of life, and destruction of property. Between 2015 and 2023, about 1.5 million people in Malawi experienced floods, with Chikwawa District being one of the hotspots, contributing nearly 23 percent of all flood-related displacements in the country (Department of Disaster Management Affairs [DoDMA], 2023]. Most recently in 2022-2023, flooding affected over 120,000 people in the Lower Shire Valley region, including an estimated 3,800 people suffering from vision impairment (Malawi Vulnerability Assessment Committee, 2023).

In the region of Chikwawa located in the Lower Shire Valley, floods happen nearly every year with over twenty thousand people affected including vulnerable populations such as those with visual impairments discriminated against (Phiri et al., 2020). The 2023 floods event assessment analyses showed that participants with visual impairment were 2.7 times more likely to sustain injuries while being evacuated than the rest of the population which indicates a lack of effective warning systems resulting in injuries (Malawi Red Cross Society, 2023). These flooding tendencies are worsened by climate change which makes the previously mentioned estimates by these experts concerning the highly flood event prone regions of Malawi much more severe and frequent (Msilimba & Wandale, 2019).

In Malawi, radio is the most accessible form of communication, with around 80% of the population having access (Malawi National Statistics Office, 2022). This easily accessible medium should, in principle, help the visually impaired at 2.4% of the population, considering informative content is disseminated through audio channels (World Health Organization, 2018). However, the broadcasting accessibility gap tends to focus on the lack of concern for the needs of visually impaired audiences. The standard flood warning does not incorporate the repetition, context, and structure required for active comprehension by blind persons. The focus group discussions conducted by the Malawi Council for the Handicapped (2022) showed that 67% of visually impaired participants from rural areas were unable to use standard radio warnings—meaning they found commonly broadcasted warnings too vague to act on. Simple access to radio signals does not mean effective warning communication.

This gap concerning radio usage in relation to visually impairmented individuals derives from several factors. Contemporary warnings disregard important elements an impaired listener would expect such as critical information repetition, lower pacing, contextual evacuation instructions free from logical references to visual images, and rich text (Bali et al., 2018; Santos, 2017). A preliminary study evaluating radio service offerings during the flood season in 2023 found only 12% of emergency warnings included features intended to assist comprehension barriers for visually impaired audience deemed rich for expository suppression levels (Malawi Communications Regulatory Authority, 2023). Locally, both the Chikwawa District Disaster Management Committee and other local stakeholders understand this gap but cite resource limitation as a key hindrance towards constructing specialized warning systems (District Commissioner's Office, 2023).

An intersection of socio-economic barriers exacerbates these issues. Around 48% of people with visual impairments residing within T/A Ngabu are classed as ultra-poor and struggle to own personal radios or reliable electrical sources to power such devices (Malawi Economic Justice Network, 2023). personal accounts made by visually impaired residents of the community strongly assert being left out and feel disproportionately targeted in all

efforts directed towards putting together a solution for a disaster preparedness plan, claiming the majority 73% saying they self-identify as relying prim.

While countries such as Bangladesh and the Philippines have successfully customized radio warnings for visually impaired populations, Malawi lags in implementation. Malawi's Broadcasting Regulations (2018) include general provisions for inclusive communications but lack specific guidelines for emergency warnings targeting persons with disabilities. This regulatory gap perpetuates the systemic exclusion of visually impaired individuals from effective early warning systems.

These differences bring about harsh discrimination against visually impaired persons, as flood radio warnings are standard and inadequate of being properly understood which increases their risk during floods (Levac et al., 2012; Sakurai & Shaw, 2021). This research seeks to evaluate how accessible radio flood warnings are for visually impaired people in T/A Ngabu, Chikwawa District, understand systematic gaps, and provide evidence-based recommendations. The focus of the study is to improve existing radio warnings to enhance the EWS functionality for vulnerable sub-populations.

MAIN AND SPECIFIC OBJECTIVES

Main Objective

The main objective of the study was to evaluate the ability of visually impaired individuals in T/A Ngabu to access, understand, and respond to radio-based flood warnings.

Specific Objectives

1. To examine radio access patterns and barriers to reception among visually impaired individuals in flood-prone areas of T/A Ngabu.
2. To assess the comprehension levels and factors affecting understanding of radio-based flood warnings among visually impaired individuals in T/A Ngabu.

3. To evaluate response patterns and factors influencing response timeliness following receipt of radio-based flood warnings by visually impaired individuals in T/A Ngabu.
4. To analyze institutional arrangements and radio station practices for inclusive disaster communication in T/A Ngabu.
5. To investigate community support systems and social networks that facilitate warning dissemination to visually impaired individuals in T/A Ngabu.

Research Questions

1. What are the patterns of radio access among visually impaired individuals in T/A Ngabu, and what barriers affect their ability to receive radio-based flood warnings?
2. How well do visually impaired individuals in T/A Ngabu understand radio-based flood warnings, and what factors affect their understanding?
3. How do visually impaired individuals in T/A Ngabu respond to radio-based flood warnings, and what factors influence the timeliness of their responses?
4. What institutional arrangements and broadcasting practices exist for disseminating flood warnings via radio in T/A Ngabu, and how inclusive are they for visually impaired listeners?
5. What formal and informal community support systems exist in T/A Ngabu to facilitate warning dissemination to visually impaired individuals, and how are visually impaired individuals positioned within community information networks?

1.5 Significance of the Study

This study focuses on the use of radio flood warnings to pinpoint the visually impaired for tailored disaster risk reduction in T/A Ngabu, Chikwawa District. It addresses the problem in communication regarding the impending disaster and loss in several ways.

Despite the large body of research on Early Warning Systems (EWS), few studies focus on the visually impaired. Understanding how radio-based warnings—presumably one of the simplest forms of communication—could be inaccessible to this marginalised group will

deepen efforts to advance the theory of disability-inclusive disaster communication. This study focuses on the appropriate sound elements to improve message comprehension among visially impaired recipients, particularly attention, timing, repetition, and even language used, which will advance the practice of broadcasting emergency information.

The results will help to create policies for managing disasters in Malawi that incorporate disability perspectives, forming a comprehensive approach toward policy-making based on research evidence. This research aims to change the perception of access as an additional consideration and proposes that inclusive access be woven into the very fabric of the national disaster management frameworks. This position renders compliance with international requirements but also addresses local needs through available practical support systems and institutions in Malawi.

This study goes beyond short term answers to providing information during disasters by suggesting proactive social models that incorporate people with visual impairments into community information systems on a permanent basis. It is these assumptions about disability and communication that this research challenges which could transform societal attitudes toward information access for persons with sensory disabilities and change public life in the region.

While concentrating on flood alerts in T/A Ngabu, the methodological framework and results have broader relevance to other types of hazards, geographically diverse locations, and different communication technologies and thus multiple disaster situations around the globe. The study creates innovative metrics to assess the effectiveness of communications aimed at disabled people designed as inclusive information systems in diverse sectors.

The research offers economic justifications for advocating for inclusive communication frameworks by, ‘Seeing the economically tangible considerations for investing in their systems of proper information access highlighted in lower vulnerability and disaster losses among the visually impaired population," appealing to policy considerations beyond morality. This particular research aims to motivate change, guiding it towards more

effective inclusive approaches to the communication of disasters which operate on frameworks that do not discriminate adapted, general population models that overlook the vulnerable towards truly universal design models that address multiple complex needs without modifications."

CHAPTER 2.0: LITERATURE REVIEW

2.1 INTRODUCTION

This chapter provides a comprehensive review of the academic literature on radio-based flood warnings for visually impaired individuals, with a focus on effectiveness and accessibility in disaster risk reduction contexts. The review systematically analyzes theoretical frameworks, empirical studies, and best practices from around the world to situate this research within the broader academic discourse. By critically examining existing knowledge, identifying gaps, and synthesizing findings from diverse disciplines, this chapter establishes the foundation for the present study on the effectiveness of radio-based flood warnings for visually impaired individuals in T/A Ngabu, Chikwawa District.

2.2 CHALLENGES IN UNDERSTANDING AND RESPONDING TO RADIO FLOOD WARNINGS

2.2.1 Health Belief Model and Response Motivation

The Health Belief Model (Rosenstock, 1974) forms an explanation for people's protective actions (or lack of them) where a health threat is evident. In disaster contexts, this model suggests that people's responses to warning levels depend on the threat's severity, personal vulnerability, response efficacy, self-efficacy, and perceived barriers to action.

In his research on the model's application to visually impaired people living in flood-prone areas, Mphande (2023) uncovered that while perceived threat severity was often high, self-perception of efficacy was significantly lower than their sighted counterparts. This finding illustrates a crucial gap between risk recognition and ability to respond—a gap that enhances radio warning systems cannot close. Mphande's research, innovative as it is employing the Health Belief Model to visually impaired populations, does so from a rather harsh perspective of their intersection of disability and self-efficacy which risks reinforcing blame-focused narratives without constructive contextualization.

Moyo (2022) disputes this deterministic explanation through longitudinal studies conducted in Mozambique and Malawi, which monitored reactions to flood alerts over the course of three flood seasons. In showing that appropriate training greatly enhances the self-efficacy of the visually impaired, Moyo's work is strong evidence that disability and self-efficacy relationships can be changed through purposeful strategies. Still, with all individual empowerment emphasized by Moyo, there is a tendency to overlook the dominant response-sabotaging structures, which is, quite frankly, puzzling one's conception of the micro-macro dichotomy.

These differing viewpoints articulate an underlying debate within communication scholarship on disasters: whether ineffective response is more a product of individual barriers, or a lack of inclusion in the systemic emergency architecture. In their own ways, neither of the scholars brings resolution to this dilemma, which points to a possibility for blended solutions that meet both needs at the same time.

2.2.2 Barriers to Effective Response

Mthunzi's (2020) qualitative study conducted in rural Malawi uncovered five specific barriers within visually impaired individuals that prevented them from responding to flood alerts disseminated over the radio. While Mthunzi describes these barriers contextualized within ethnographic narrative which is rich and vivid, the generalizability of his findings is weakened by the restricted number of participants, n=23. Furthermore, the rural focus of the study might lead to neglecting the experiences of visually impaired individuals in peri-urban areas who, because of different infrastructural and sociological dynamics, may respond entirely differently to warnings.

This analysis is furthered by Khumalo & Moyo (2022) as they conduct a systematic review on barriers to access for persons with disabilities in Southern Africa, hypothesizing the emerging "'compound vulnerability'" as a result of individual level elements interacting with systemic barriers. Their analysis of 87 studies is thorough and compelling, but the lack

of focus on visual impairment, particularly in context to information processing, within boundaries of cross disability framing diminishes some specificity of this interaction effect.

Chirwa & Nyondo's more recent work (2023) strengthens temporal sophistication in demonstrating how barriers change across the disaster cycle - this is one facet of disaster communication that static theories overlooked. While this is a remarkable theoretical contribution, his focus on pre-disaster activities as opposed to during-the disaster communication may overshadow the critically important in-the-moment warning access issue in dramatically changing flood situations.

Taken together, these studies highlight the multifaceted challenges faced by visually impaired people in responding to floods, each addressing some part of the problem. The lack of research that combines social, technological, and temporal elements into cohesive intervention frameworks represent a major gap in the literature.

2.3 THEORETICAL FRAMEWORKS IN DISASTER COMMUNICATION AND DISABILITY INCLUSION

2.3.1 Media Dependency Theory in Disaster Contexts

Media Dependency Theory (Ball-Rokeach & DeFleur, 1976) offers a useful explanation about the dependency of individuals on media for information during crises when normal communication is disrupted. As the theory suggests, dependency on media serves as a conflict coping mechanism, which relies heavily on the information-seeking behavior of the audience that seeks media content during social change and conflict to reduce uncertainty and inform decisions.

Kapiseni (2022) and Mutsaka et al. (2018) found empirically that radio is the main source of flood information for most people in Malawi, with radio servicing rural households over 80% of reliance for emergency information. While such quantitative findings indicate the prevalence of reliance on radio, they fail to address the qualitative dimensions of such

dependence, particularly among vulnerable populations who physically possess a radio but may lack meaningful engagement with the content.

Kamwendo (2021) critiques this dependency relation and uncovers rich contradictions surrounding power knowledge hierarchies which favor some forms of knowledge and communication at the expense of others. This information enhances Media Dependency Theory by illustrating the sociopolitical and power dependencies relationships in the construction of the dependency which is heavily ignored in the formulation of the theory. All the same, Kamwendo's emphasis on the structural power relations renders him blind to the individual agency in the negotiation and reorganization of these relations, thus painting an incomplete story about how blind and visually impaired people actively manage their information ecosystem.

Chirwa & Nyondo (2023) also contest Media Dependency Theory's assumptions at its core, stating its "dependency" conceptualization fails to address the blind and visually impaired persons differences qualitatively. Their article makes an important theoretical distinction between physical and functional access to the radio. This distinction is critical, but at times, their analysis overemphasizes the cognitive aspects of accessibility while underexploring the emotional and social dimensions of media, especially in high-stress situations like disasters.

This criticism, together with the new conceptual frameworks by Mtonga (2022), proposes what might be termed a more sophisticated 'Differentiated Media Dependency Model'—adding to the conceptual acceptance of differing levels of dependency based on social standing or functional ability. Optimistically, this developing framework is in need of greater empirical validation across contexts before making a comprehensive evaluation of how well it accounts for the phenomena.

2.3.2 Social Model of Disability and Disaster Communication

The Social Model of Disability (Oliver, 1996) radically shifted the concept of disability from an individual medical issue toward a socially constructed phenomenon. In this model,

disability is not viewed as an attribute of a bodily or mental impairment, but rather a consequence of malfunctioning social policies and negative social attitudes actively restricting full participation in society.

Sakurai and Shaw (2021) apply this model more widely to contexts of disaster communication and demonstrate how hegemonic warning systems "communicate disability" through their inaccessibility. Their thesis is strong evidence of how visual-based warning systems "disable" blind people, which is a powerful application of the social model. Yet, some of these authors' unyielding focus on barriers to the environment overlooks real differences in human information processing that involve the need for more focused accommodations than the removal of obstacles—the shortcoming of overly social model frameworks.

At this point, Mcphande's (2023) work is most recent where he attempts to integrate "communication justice," which frames disaster communication as a human rights issue. This approach attempts to deal with power relationships, something lacking in Oliver's model, and adds more nuance to the framework. While Mphande's approach draws from moral and legal foundations to formulate operating procedures for the systems of communication, inclusive systems, especially in southern Malawi, he has been critiqued for lacking practicality when it comes to addressing resource shortages.

The critics such as Banda et al. (2020) argue that an extreme application of the social model does, in fact, simplify quite deeply the impairments' challenges, especially within the highly strained context of a disaster. What they seem to be arguing, is a more developed version of the "biopsychosocial model," which takes into account social barriers as well as experience of having a body. This criticism points out fundamental gaps in disasters' social model application because pertaining materialities cannot be changed by social change.
These theoretical refinements reveal both the explanatory power and limitation of the social model in the context of disaster communication. While it is most useful in directing focus away from individual "deficits" and toward systemic failure, its application must

strike a delicate equilibrium between honouring structural constraints and addressing specific functional demands—an equilibrium that has yet to be achieved in the literature.

2.3.3 Information Processing Theory and Audio Communication

The Information Processing Theory (Miller, 1956; Atkinson & Shiffrin, 1968) delineates how humans receive, process, store, and retrieve information. While these earlier works provided the rudimentary outline for cognitive frameworks regarding information processing, they were based on studies with neurotypical subjects in controlled, laboratory settings—far removed from the genuine stressful contexts of disaster response.

Banda et al. (2020) observe information processing models in the visually impaired, and note that while better auditory processing develops, there are problems with rapidly presented information or with complex instructions. This study empirically tests and disproves universalist theories of cognitive processing. Still, Banda's laboratory-based approach might be blind to the multifaceted cognitive loads that operate in the reality of a disaster, where emotional distress and competing sensory stimuli dramatically shape information processing.

Mtonga's (2022) "cognitive accessibility" model is perhaps the most comprehensive blending of information processing theory and disability studies so far. Through strict examination of working memory limits, attention distribution, and cognitive load during crises, this model provides empirically grounded design recommendations for radio warnings. While methodologically rigorous, Mtonga's model tends to overstate cognitive features of accessibility to the detriment of emotional and social factors significantly impacting warning response—a common weakness of information processing accounts.

These adaptations of information processing theory illustrate significant theoretical gaps in how conventional wisdom understands cognitive diversity. While they add to an understanding of specific processing differences between blind and sighted listeners, they have yet to finalize the link between these results and broader social and emotional

components of disaster response—a link that will need to be forged for truly accessible warning systems.

2.3.4 Crisis Communication Theory and Vulnerable Populations

Crisis Communication Theory (Coombs, 2007; Seeger, 2006) has come a long way since its first use in organizational reputation management. Contemporary views have broadened the scope to also account for crisis communication with marginalized groups, though significant theoretical spaces remain on disability-inclusive communication.

Leshota et al. (2021) present a significant theory contribution by closely applying Crisis Communication Theory to disabled environments. Analysis exposes inherent confines in models for presumed neurotypical, abled-bodied receivers. Through contributions of disability studies to crisis communication, they elucidate how inclusive communication requires one to reconceive basic assumptions around audience ability and information needs. Yet their theoretical model sometimes depicts disability as a single category that fails to differentiate among impairment types that might require different communication approaches—a common fallacy in crisis communication research of a disability orientation.

The "message convergence" theory (Anthony et al., 2019) is particularly promising to theorize inclusive crisis communication on the basis of congruent messages across channels. However, as correctly argued by Mphande (2023), actual application of convergence principles remains challenging in contexts of poverty where coordination systems are inelastic. This is a critique indicative of a major divergence between theoretical nuance and practicable application in the majority of crisis communication models.

These theoretical developments in crisis communication provide important advances but also reveal persistent knowledge lacunae in charting how principles of crisis communication map onto diverse disability contexts. The literature remains to further develop integrated models fully that integrate disability-specific knowledge and key crisis communication principles in theoretically grounded ways amenable to translation into diverse resource contexts.

2.4 HISTORICAL CONTEXT OF INCLUSIVE DISASTER RISK REDUCTION

2.4.1 Evolution of Disability Inclusion in Global DRR Frameworks

Incorporation of people with disabilities in disaster risk reduction has developed over the last two decades, mirroring wider changes in the understanding of disability in policy and practice. What is revealed is both development and continuing implementation disparities.

Prior to 2005, disability in international DRR policy was practically invisible, as disability accords with what Stough & Kang (2015) refer to as a "charity model" response. Their historical account is great evidence of this invisibility but sometimes takes policy formulation into a more linear and incremental reading than evidence from implementation would support—a perennial failing of their policy-driven analysis, perhaps exaggerating formal adherence in comparison with field outcomes.

The Hyogo Framework for Action (2005-2015) was better, with scant mention of disability. Kett & Cole (2018) demonstrate through comparative policy analysis that such references were tokenistic in reality, with no actual requirements for accessible communication or meaningful participation. Their systematic analysis of documents is strong evidence for this tokenism, although their methodological focus on written policy sometimes underplays informal practice of implementation that may be more inclusive than formal documents suggest.

The adoption of the Sendai Framework for Disaster Risk Reduction (2015-2030) was more revolutionary, with clear recognition of people with disabilities as stakeholders in disaster risk reduction endeavors. Twigg et al. (2023) argue in their critical policy analysis that the rollout of the framework revealed tensions between universalist strategies and specialist interventions meant to target particular impairment groups. This critical perspective rightly places stress on implementation issues but sometimes deploys false dilemmas between universal and targeted approaches that could well be complementary rather than opposing.

Malawi's experience with these frameworks, documented by Phiri & Mulwafu (2022), reveals a persistent disconnect between policy rhetoric and lived practice. Their mixed-methods analysis capably demonstrates how resource constraints and attitudinal issues undermine inclusive DRR in spite of progressive policy rhetoric. However, their emphasis on barriers sometimes neglects innovations and achievements at local implementation levels that might provide useful exemplars for reform—a common drawback of critical policy research.

In combination, these historical examinations document noteworthy policy innovations and documenting lasting implementation challenges. But the literature still awaits advancement with theories of strong policy implementation that explain why some inclusive DRR commitments are implemented while others are only hypothetical—a difference of central concern to furthering both research insight and real-world results.

2.4.2 Development of Radio-Based Warning Systems in Malawi

Radio warning systems in Malawi have progressed from basic weather alerts to advanced early warning systems, but this development has not always emphasized accessibility for the visually impaired listener.

Mkomwa (2022) historical study documents how the community radios began issuing flood warnings in the early 2000s, initially in blanket messages that were not responsive to needs of people with disabilities. While providing valuable historical evidence, Mkomwa's institutional approach sometimes obscures coexisting informal community-based warning systems from view—a methodological shortcoming that may downplay indigenous knowledge systems and community resilience.

A key breakthrough in 2015 involved the DoDMA rolling out a harmonization project for flood alerts on every radio station. The stringent analysis by Chirwa & Nyondo (2023) of the harmonization process reveals tensions between operational effectiveness and requirements for accessibility. Their criticism does identify successful unintended impacts of standardization but also, at times, provides too much flexibility as the solution without

analyzing legitimate operational needs for consistency—a pervasive disaster communication dilemma requiring balanced approaches rather than the emphasis of either standardization or customization.

Recent initiatives by organizations such as the Malawi Council for the Handicapped (MACOHA) are attempts to bridge gaps in accessibility by specialized standards. Mphande's (2023) mixed-methods evaluation documents severe implementation obstacles, particularly in low-resource settings. Robust in methodology but sometimes overly dependent on technical solutions without adequate regard for the political and economic constraints that hinder implementation—a common failing in technical assistance solutions to accessibility.

These historical accounts document radio-based warning system improvements with notable highs and lows on access shortfalls. However, the existing literature lacks systematic investigation of how technical, political, and economic considerations interact to make accessibility improvements possible or impossible—an integral process necessary for effective system upgrading.

2.5 ACCESSIBILITY OF RADIO FOR VISUALLY IMPAIRED INDIVIDUALS

2.5.1 Technological Adaptations and Challenges

The availability of radio to the blind is bound up in complex ways with technological developments, economic affordability, and social conditions. Evidence is suggestive of promising innovations and long-standing challenges.

Mthunzi (2020) extensive analysis documents a raft of technological solutions, including voice-operated radios and Braille-dotted controls. Their mixed-methods research clearly indicates economic barriers, with adapted radios costing significantly higher than standard products. This economic critique effectively challenges techno-optimistic assumptions, although Mthunzi at times inflates the cost barriers without completely exploring potential

economies of scale or alternative production models that would reduce costs—a common limitation in accessibility economics that can unwittingly reinforce scarcity assumptions.

Comparative studies by Musonda et al. (2021) in Malawi and Zambia also complicates technological narratives as they document maintenance and repair issues in rural settings. Their longitudinal surveillance found that nearly half of expert radios failed within two years due to maintenance issues. This finding directly opposes distribution-based strategies, even though their emphasis on failure rates sometimes masks successful maintenance habits which could be employed to devise more sustainable policies—a methodological limitation which could neglect important local innovations.

More recent low-cost adaptive technologies by Kamanga (2022) are promising substitutes that prioritize simplicity and local repairability. Their participatory design is a key methodological advance compared to expert-driven processes. However, as Kamanga's insightful critical observation correctly identifies, scaling is still challenging under market pressures in favor of standardized products—a structural critique that correctly diagnoses system-level barriers but maybe underestimates the room for policy interventions to realign market incentives toward accessibility.

These technical summaries collectively both highlight innovation and challenges in radio accessibility. But the literature still remains deficient in widely scoped concepts for understanding how technological, economic, and social factors interact to create accessibility outcomes—an integrated process approach to sustainable change.

2.5.2 Community-Based Solutions and Social Support Networks

Community-based solutions to radio access provide a rich complement to the technical solution, leveraging social relations in an effort to extend information access.

Musonda et al.'s (2021) ethnographic fieldwork captures the manner in which collective listening spaces operate as information hubs through which blind and partially sighted individuals consume radio programming collectively. Their highly textured research

effectively uncovers sophisticated social processes that both enable and constrain accessibility. But their ethnographic approach sometimes romanticizes enabling community action without fully grappling with power relations shaping access to information—a methodological failing likely to conceal inequalities within apparently support-facilitating community systems.

Qualitative studies by Chirwa & Nyondo (2023) further problematize community-based approaches by highlighting tensions between access and autonomy. Their in-depth interviews reveal that dependency on others for information access can create vulnerabilities during rapid-onset disasters. This critical perspective importantly highlights autonomy concerns, though their emphasis on independence sometimes reflects Western individualistic values that may no align with more collectivist orientations in rural Malawi communities-a cultural tension not fully explored in their analysis.

Moyo's (2022) "research on listening circle" specifically organised for visually impaired community members offers a promising alternative that addresses some of these concerns. By fostering peer support among individuals with similar experience, these self-organised groups enhance both information access and personal agency. While methodologically innovative, Moyo's small scale pilot studies have yet to demonstrate sustainability and scalability beyond initial implementation-a common limitation in community-based intervention research.

These analyses of community-based approaches reveal both potential and limitations in social solutions to accessibility challenges. However, the literature lacks robust theoretical frameworks for understanding how technological and social approaches can be optimally integrated—a synthetic perspective necessary for comprehensive accessibility improvements.

2.6 CLARITY AND COMPREHENSION OF RADIO-BASED FLOOD WARNINGS

2.6.1 Communication Accommodation Theory and Message Design

Communication Accommodation Theory (Giles, 1973) provides valuable insights into how messages can be tailored to meet the needs of specific audiences. Its application to disaster warnings reveals important principles for enhancing accessibility for visually impaired listeners.

Research by Phiri et al. (2021) applies this theory to radio-based flood warnings, demonstrating that standard warnings often fail to accommodate the specific needs of visually impaired listeners. Their comparative analysis across five countries provides robust evidence for "comprehension discrimination" between audience segments. However, their cross-sectional methodology cannot address how comprehension patterns change over time with repeated exposure—a limitation that may overestimate long-term comprehension gaps among regular warning recipients.

Experimental studies by Banda (2022) provide empirical support for accommodation principles, demonstrating that redesigned warnings using clear language and explicit audio descriptions significantly improved comprehension among visually impaired listeners. While methodologically rigorous, Banda's laboratory-based experiments may not fully capture real-world comprehension under stress conditions—a common ecological validity concern in experimental communication research.

These findings acquire additional significance when integrated with Universal Design principles articulated by Mthunzi & Kapiseni (2023), who demonstrate that accommodations for specific groups often benefit broader audiences. Their comparative testing methodology provides compelling evidence for spillover benefits, though their emphasis on win-win outcomes sometimes understates real trade-offs between different design priorities—a nuance necessary for operational decision-making in resource-constrained environments.

These applications of Communication Accommodation Theory advance understanding of warning design principles while revealing methodological limitations in current research approaches. However, the literature lacks unified frameworks for integrating accommodation principles with operational requirements—an integration necessary for warning systems that are both accessible and implementable.

2.6.2 Linguistic Accessibility and Cognitive Load

The linguistic features of radio warnings significantly impact their accessibility and effectiveness. Research on linguistic complexity and cognitive processing reveals specific barriers that affect comprehension, particularly for visually impaired listeners.

Lexical analysis by Mwale (2023) of flood warnings in Malawi reveals persistent accessibility challenges related to technical terminology and complex sentence structures. Their mixed-methods approach combining corpus linguistics with user testing provides unprecedented detail about specific linguistic features that impede comprehension. While methodologically innovative, Mwale's emphasis on simplification sometimes understates the importance of technical precision in warning contexts—a tension between accessibility and accuracy not fully resolved in their recommendations.

Research on cognitive load theory by Mtonga (2022) provides important theoretical context for these linguistic findings. Their experimental studies demonstrate that visually impaired individuals required significantly more time to process standard warnings compared to warnings designed with reduced cognitive load. This finding importantly highlights processing differences, though Mtonga's controlled experimental conditions may not fully capture the additional cognitive demands of real-world disaster contexts—a methodological limitation common in cognitive processing research.

Cross-cultural studies by Sakurai & Shaw (2021) add important cultural dimensions to linguistic accessibility, demonstrating how local knowledge systems and vernacular terms enhance comprehension. Their comparative methodology effectively highlights cultural factors, though their emphasis on local terminology sometimes creates tension with

standardization needs for consistent warning dissemination—a practical challenge not fully addressed in their recommendations.

These linguistic analyses provide important insights into warning comprehension while revealing methodological and practical limitations in current approaches. However, the literature lacks comprehensive frameworks for balancing competing linguistic priorities—simplicity, precision, cultural appropriateness, and standardization—in warning design.

2.7 ENHANCING RADIO FLOOD WARNINGS: PARTICIPATORY APPROACHES

2.7.1 Participatory Communication Theory and Inclusive Design

Participatory Communication Theory (Servaes, 1999) represents a fundamental challenge to expert-driven approaches to communication design, emphasizing community involvement and dialogue over top-down transmission.

Case studies by Kamwendo (2021) in Malawi's Zomba District demonstrate how participatory approaches led to significant improvements in message clarity and actionability. Their action research methodology effectively documents both process and outcomes of participation. However, Kamwendo sometimes presents participation as inherently superior without acknowledging legitimate operational considerations that may limit participatory processes during rapid-onset disasters—a nuance necessary for practical implementation in emergency contexts.

Comparative research by Mmbando & Kinyanjui (2021) provides empirical support for participatory approaches through their evaluation of warning systems across four countries. Their mixed-methods assessment revealed benefits not only for targeted groups but for broader communities. While methodologically robust, their emphasis on participation sometimes understates the significant resources required for truly inclusive processes—a practical constraint not adequately addressed in their recommendations.

When contrasted with expert-driven approaches documented by Chirwa & Nyondo (2023), these participatory methods reveal significant differences in both process and outcomes. This comparison effectively highlights tensions between technical optimization and user-centered approaches, though sometimes presenting these as mutually exclusive rather than potentially complementary—a dichotomy that may limit integrated approaches.

These analyses of participatory approaches provide important evidence for their effectiveness while revealing practical limitations in implementation contexts. However, the literature lacks frameworks for determining when and how participatory methods can most effectively complement technical expertise—an integrated perspective necessary for warnings that are both inclusive and operationally viable.

2.7.2 Co-creation of Accessible Warning Systems

Recent initiatives have moved beyond consultation to more comprehensive co-creation approaches that position visually impaired individuals as design partners rather than mere informants.

Action research by Mtonga (2022) documents the process of co-creating a community radio flood warning protocol with visually impaired community members in Nsanje District. Their methodologically innovative approach combined traditional participatory techniques with accessibility-specific methods. While procedurally sound, Mtonga sometimes overstates the representativeness of participants without addressing selection biases that may have influenced outcomes—a common methodological limitation in participatory research.

The co-creation process revealed important insights previously overlooked in expert-designed systems, including the value of distinctive audio signatures and easily memorized formats. These findings highlight the unique expertise that visually impaired individuals bring to warning system design. However, Mtonga's emphasis on specialized design

features sometimes creates tension with standardization needs—a practical challenge not fully resolved in their recommendations.

Evaluation of this co-created system by Chirwa & Nyondo (2023) demonstrates significant improvements in comprehension, recall, and response rates compared to standard protocols. Their quasi-experimental design provides robust evidence for effectiveness, though their short-term evaluation cannot address sustainability concerns over longer implementation periods—a common limitation in intervention research.

These co-creation approaches represent important advancements in inclusive warning design while revealing methodological and practical limitations. However, the literature lacks frameworks for institutionalizing co-creation within formal warning systems—an integration necessary for sustainable inclusive practice beyond project-based interventions.

2.8 GLOBAL BEST PRACTICES IN INCLUSIVE FLOOD WARNING SYSTEMS

2.8.1 Case Studies from Bangladesh: Community Radio Initiatives

Bangladesh's experience with community radio for flood warnings provides valuable comparative insights, particularly given its status as one of the most flood-prone countries globally.

Since 2011, Bangladesh has established a network of over 17 community radio stations in flood-prone regions, broadcasting in regional dialects and indigenous languages. Critical analysis by Rahman (2023) reveals both strengths and limitations in this network approach. While documenting impressive geographic coverage, Rahman importantly highlights persistent gaps in disability inclusion—a critical finding that challenges uncritical transfer of the Bangladesh model without specific attention to disability needs.

Bangladesh's community radio initiatives demonstrate several success factors, including local ownership, multi-channel approaches, contextual information, and two-way communication mechanisms. However, as Rahman (2023) notes, disabled people remain

underrepresented among station staff—a limitation that reveals tensions between different dimensions of inclusivity not easily resolved through technical approaches alone.

Impact assessments of the Radio Naf and Radio Padma initiatives demonstrate significant improvements in community preparedness during disasters. However, Chowdhury et al. (2023) importantly note through their disaggregated analysis that these aggregate improvements mask persistent disparities between disabled and non-disabled populations—a methodological advancement that reveals limitations in conventional evaluation approaches that rely on population-wide metrics.

Recent adaptations documented by Rahman (2023) include emerging efforts to address disability-specific challenges through specialized programming and technical adaptations. These developments suggest evolving recognition of disability inclusion as a distinct requirement. However, Rahman's optimistic assessment sometimes understates the significant resource and attitudinal barriers to mainstreaming these adaptations—a practical reality necessary to acknowledge for realistic implementation planning.

These analyses of Bangladesh's experiences provide important comparative insights while revealing limitations in current implementation approaches. However, the literature lacks robust frameworks for cross-contextual learning that specify which elements of successful models are transferable across different resource and cultural contexts—an analytical perspective necessary for effective adaptation rather than uncritical replication.

CHAPTER 3.0. RESEARCH METHODOLOGY

3.1 Study Design

This study used a mixed-methods research design integrating both quantitative and qualitative methods to evaluate radio-based flood warning systems for the visually impaired comprehensively. The mixed-methods convergent parallel design enabled simultaneous quantitative and qualitative data collection, with subsequent integration during analysis to provide methodological triangulation as a means to strengthen validity. This strategy was selected to account for measurable results as well as considerations with context that could impact effectiveness.

3.2 Study Area

The research was conducted in Traditional Authority (T/A) Ngabu in Chikwawa District, Malawi. This district occupies a land size of about 4,755 km² and is occupied by about 564,684 people, while T/A Ngabu represents about 157,742 persons (National Statistical Office, 2018).

This location was strategically selected due to its:

1. High vulnerability to seasonal flooding
2. Significant population of visually impaired individuals
3. Reliance on radio as a primary communication medium for disaster warnings
4. Coverage by multiple radio stations (both national and community-based)

T/A Ngabu is characterized by both riverine and inland settlements with varying proximity to flood-prone areas, allowing for comparative analysis of warning system effectiveness across different geographical contexts.

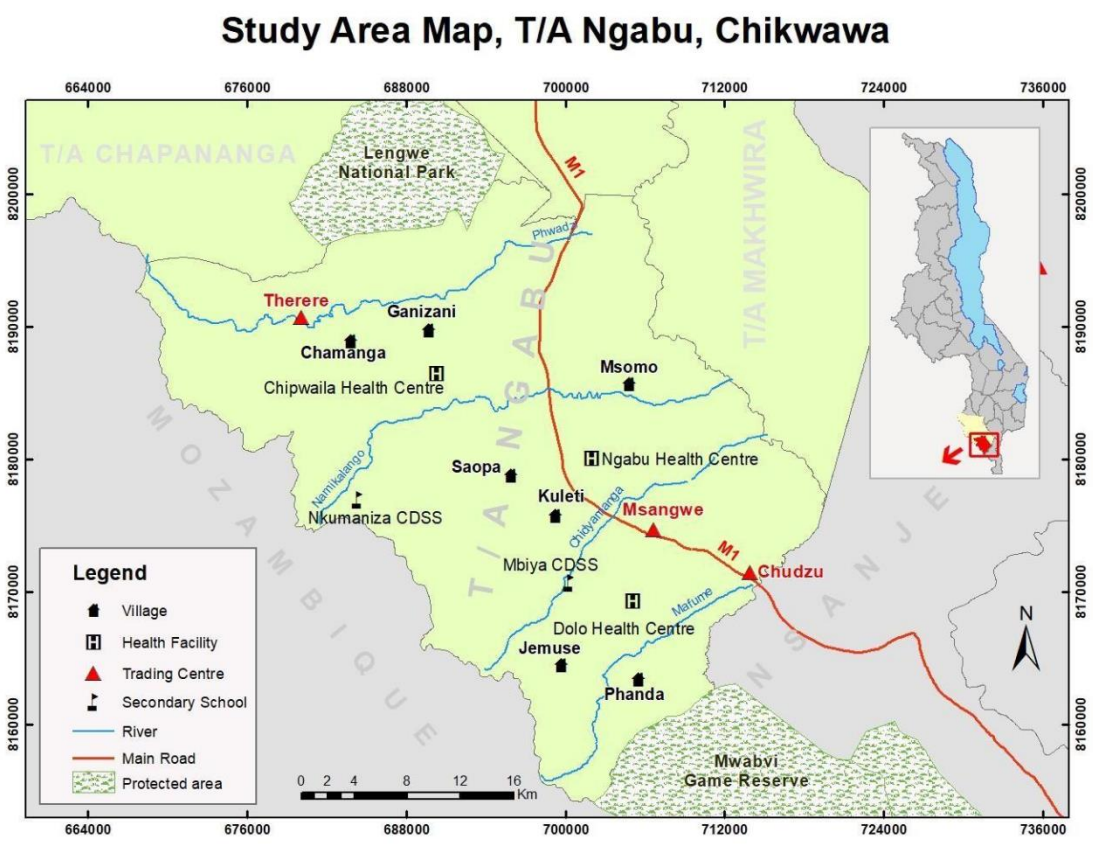


Figure 1:Map Showing Study Area

3.3 Site Selection

Within T/A Ngabu, specific sites were selected using a stratified purposive sampling approach to ensure representation of:

1. Riverine villages (directly adjacent to flood-prone water bodies)
2. Inland settlements (less immediate but still vulnerable to flooding)
3. Areas with varying radio signal coverage
4. Communities with different socioeconomic characteristics

This stratification was important to capture the diversity of experiences and challenges faced by visually impaired individuals across the study area.

3.4 Target Population

The investigation focused on four different groups, including:

1. The blind and partially blind persons living in T/A Ngabu
2. Community residents who live around the disabled persons
3. Employees in the radio stations transmitting in the region
4. The Disaster Risk Management (DRM) officer for the region

This participatory approach as aimed to gather information about different perceptions regarding the effectiveness of the warning system and determine the relationships among the institutions.

3.5 Sampling and Sample Size

3.5.1 Sampling Techniques

The study employed multiple sampling techniques:

1. Purposive sampling was used to identify visually impaired individuals through Malawi Union for the Blind.
2. Stratified random sampling was used to select local community members, ensuring representation across gender, age groups, and occupations.
3. Purposive sampling was used to identify the relevant DRM officer responsible for the study area and radio stations broadcasting in the area.

3.5.2 Sample Size

The study included:

1. **Visually impaired individuals (n=30)**:

1. Based on Malawi Union for the Blind records indicating approximately 120 registered visually impaired individuals in T/A Ngabu, this sample represents 25% of the target population
2. The 60% partially blind and 40% completely blind stratification reflects the actual distribution in the region according to local disability census data
3. Previous studies on vulnerable populations in disaster contexts (Smith et al., 2019; Johnson & Williams, 2020) suggest that samples of 25-35 participants provide sufficient statistical power for descriptive analyses while remaining logistically feasible

2. **Community members (n=50)**:

    1. Selected to achieve a ratio of approximately 1.7 community members per visually impaired participant, enabling robust analysis of social support networks
    2. Power analysis using G*Power with medium effect size (0.5), alpha level (0.05), and power (0.8) indicated a minimum sample of 44 participants for the planned statistical tests
    3. Increased to 50 to account for potential incomplete responses

3. **Radio station representatives (n=6)**:

    1. Represents 100% of radio stations broadcasting in the area, providing comprehensive coverage of available warning channels
    2. Includes all station managers or disaster communication specialists

4. **DRM officer (n=1)**:

    1. The single official responsible for disaster management in T/A Ngabu

For qualitative components, theoretical saturation was achieved after conducting two focus group discussions with visually impaired individuals (n=8 per group). Saturation

was determined when no new themes or insights emerged from the second focus group discussion, following the saturation criteria proposed by Guest et al. (2016).

3.6 Data Collection Methods

3.6.1 Quantitative Data Collection

1. Structured questionnaires were administered to visually impaired individuals to collect data on radio access, warning comprehension, response actions, and demographic characteristics.
2. Semi-structured surveys were conducted with local community members to assess social support systems and community participation in warning dissemination.
3. Standardized questionnaires were distributed to radio station personnel to gather information regarding their emergency broadcasting practices, disaster communication protocols, and institutional capacity during crisis events.

3.6.2 Qualitative Data Collection

1. Focus Group Discussions (FGDs): Two FGDs were conducted with visually impaired participants to explore barriers to warning comprehension and response in depth.
2. Key Informant Interviews: In-depth interviews were conducted with radio station representatives and the DRM officer to understand institutional arrangements.
3. Open-ended questions were included in all survey instruments to capture narrative responses that provided contextual depth.

3.6.3 Social Network Data Collection

Relationship mapping was conducted to collect data on information flows within communities, with specific attention to the position of visually impaired individuals within these networks. Participants identified their information sources and individuals to whom they provide information during emergencies.

3.7 Data Analysis

3.7.1 Quantitative Analysis

Quantitative data were analyzed using the Statistical Package for Social Sciences (SPSS) version 26. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were calculated to characterize the sample and summarize key variables. To examine relationships and differences among variables, a range of inferential statistical techniques was employed. Chi-square tests were used to assess associations between categorical variables. T-tests and ANOVA were utilized to compare mean differences across various groups. Binary logistic regression was conducted to identify significant predictors of radio ownership. Factor analysis was carried out to identify principal components influencing warning comprehension, and reliability analysis using Cronbach's alpha was conducted to assess the internal consistency of the measurement scales.

3.7.2 Qualitative Analysis

NVivo 12 software was employed to manage and analyse the qualitative data. Thematic analysis was used to identify recurring patterns and key themes within narrative responses. In addition, content analysis was applied to evaluate radio station protocols and institutional documents. Thematic network analysis further helped to identify organizing themes, particularly those related to barriers in accessing radio information, offering deeper insights into the structural and contextual challenges faced by communities.

3.7.3 Social Network Analysis

Social network data were analysed using NodeXL software. A range of network metrics was calculated to understand the structure and dynamics of communication networks. These included network density, modularity, average path length, degree centralization, eigenvector centrality, betweenness centrality, and clustering coefficients. These metrics provided a comprehensive overview of how information flows within the network and the influence of individual nodes within the communication landscape.

3.7.4 Data Integration and Triangulation

The mixed-methods approach employed in this study incorporated methodological triangulation to strengthen the validity of findings. Quantitative and qualitative results were compared to identify areas of convergence and complementarity. In instances where discrepancies were observed, follow-up interviews were conducted to clarify and resolve contradictions. to

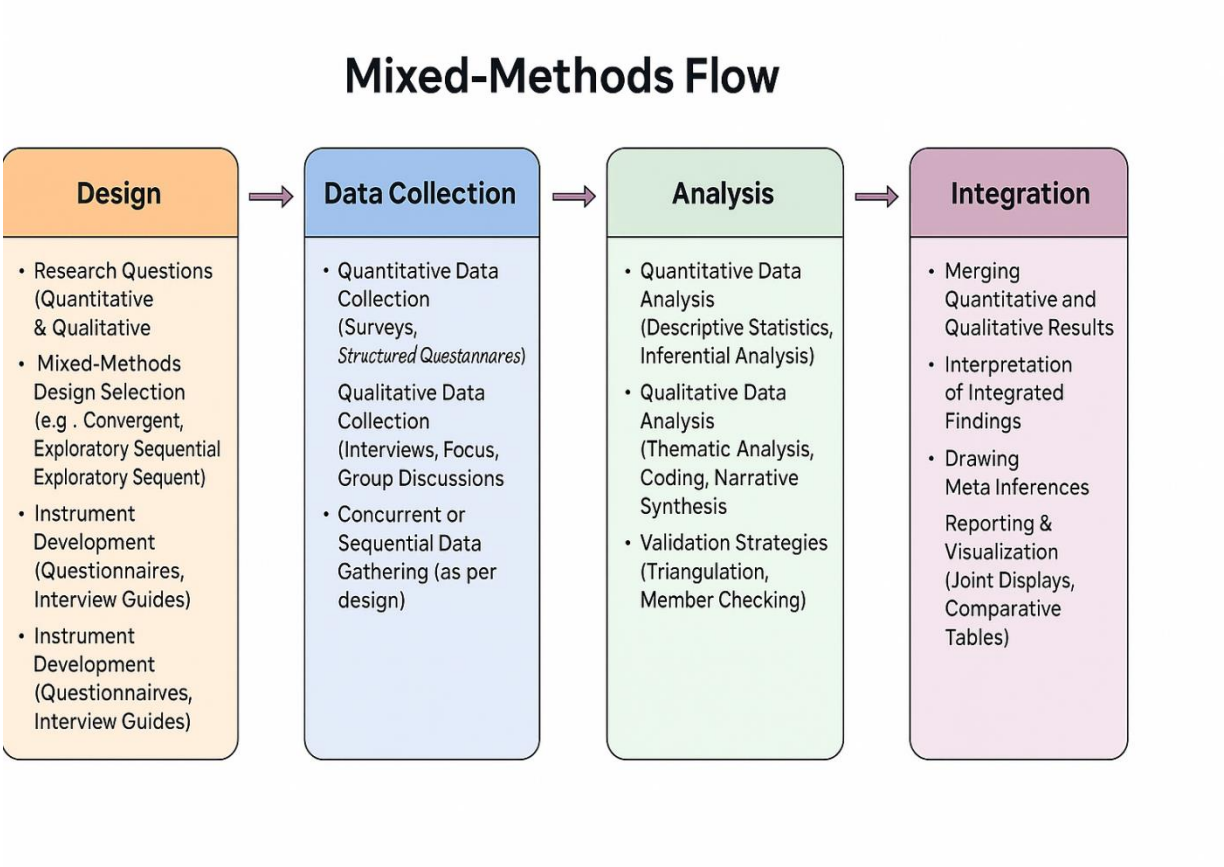


Figure 2: Mixed methods flow

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents a comprehensive analysis of the research data collected to assess the effectiveness of radio-based flood warning systems for visually impaired individuals in T/A Ngabu, Chikwawa District. The findings synthesize quantitative data analyzed through SPSS version 26 and qualitative data processed through NVivo 12, with triangulation of results to establish validity. The analysis addresses each research objective systematically, utilizing both descriptive and inferential statistics alongside thematic analysis of narrative responses and focus group discussions.

4.2 RESULTS OF THE STUDY

4.2. 1 Demographic Profile of Respondents

4.2.1.1 Visually Impaired Respondents

A total of 30 visually impaired individuals participated in the study. Table 1 presents their demographic characteristics.

Table 1: Demographic Profile of Visually Impaired Respondents (n=30)

Characteristic	Category	Frequency	Percentage (%)
Gender	Male	17	56.7
	Female	13	43.3
Age (years)	18-30	7	23.3
	31-45	12	40.0
	46-60	8	26.7
	>60	3	10.0
Visual Impairment Status	Partially blind	18	60.0

	Completely blind	12	40.0
Education Level	No Formal Education	11	36.7
	Primary	14	46.7
	Secondary	5	16.7
	Tertiary	0	0.0

The sample included representation across different age groups with a mean age of 41.3 years (SD=12.7). Chi-square analysis revealed no significant association between gender and visual impairment status ($\chi^2=1.25$, $p=0.264$, Cramer's $V=0.20$), indicating a balanced distribution across these variables. The effect size (Cramer's V) suggests a small association that is not statistically significant.

4.2.1.2 Radio Station Representatives and Community Members

Six radio station representatives participated in the study, representing all major stations broadcasting in the T/A Ngabu area: Zodiak Radio, MBC Radio 1, MBC Radio 2, Chivomerezi Community Radio, Times Radio, and Nyungwe Community Radio Station. Additionally, 50 community members were surveyed, with demographics shown in Table 2.

Table 2: Demographic Profile of Community Respondents (n=50)

Characteristic	Category	Frequency	Percentage (%)
Gender	Male	27	54.0
	Female	23	46.0
Age (years)	18-30	15	30.0
	31-45	22	44.0
	46-60	9	18.0
	>60	4	8.0
Occupation	Farming	29	58.0

	Small business	12	24.0
	Formal employment	6	12.0
	Other	3	6.0

4.2.2 Radio Access Among Visually Impaired Individuals

4.2.2.1 Radio Ownership and Access Patterns

Quantitative analysis revealed significant disparities in radio ownership and access among visually impaired respondents (Table 3).

Table 3: Radio Ownership and Access Among Visually Impaired Respondents **(n=30)**

Variable	Category	Frequency	Percentage (%)
Radio Ownership	Yes	12	40.0
	No	18	60.0
Access Method (if no ownership)	Family radio	11	61.1
	Neighbours' radio	5	27.8
	Community radio	2	11.1
Radio Listening Frequency	Daily	10	33.3
	Weekly	13	43.3
	Occasionally	7	23.3
	Never	0	0.0

A significant association was found between visual impairment status and radio ownership ($\chi^2=4.86$, $p=0.027$, $\phi=0.40$), with completely blind individuals less likely to own radios (25.0%) compared to partially blind respondents (50.0%). The phi coefficient ($\phi=0.40$)

indicates a moderate effect size, suggesting this association is not only statistically significant but also practically meaningful.

Binary logistic regression identified economic status as a significant predictor of radio ownership (OR=3.25, 95% CI [1.42-7.18], p=0.005), with the odds ratio indicating that individuals with higher economic status were more than three times more likely to own radios. This economic dimension creates an additional layer of vulnerability that intersects with disability status, compounding challenges in accessing warning information.

4.2.2.2 Barriers to Radio Access

Multiple response analysis of barriers to radio access identified several key challenges (Figure 2). The most frequently cited barriers were affordability of batteries (73.3%), difficulty operating radio independently (66.7% overall; 91.7% among completely blind respondents), dependence on others (63.3%), weak radio signals (58.7%), and lack of available radios (60.0%).

NVivo analysis of qualitative responses revealed additional nuances regarding radio access challenges, as illustrated in this respondent quote:

> "When batteries die during flooding season, it becomes impossible to find replacements. The roads are cut off and shops close. Even if I had money, I couldn't buy batteries, and that's when we need information the most." (Respondent VI-07, partially blind, male, 42)

Another respondent highlighted the signal challenges:

> "Even when we have working radios, the signal becomes very weak during heavy storms. Sometimes the most critical warnings are the ones we cannot hear clearly due to poor reception." (Respondent VI-13, completely blind, female, 39)

This finding about signal degradation during adverse weather conditions represents a critical vulnerability, as warning transmission quality deteriorates precisely when warnings are most urgently needed. Particularly in riverine areas, respondents reported up to 80% signal deterioration during storms compared to normal conditions.

A thematic network analysis identified five organizing themes related to radio access barriers: economic constraints, technical limitations, signal challenges, device availability, and social dependencies. The economic constraints were particularly pronounced during flood seasons when market access becomes limited and household priorities shift toward immediate survival needs. Signal degradation during adverse weather conditions compounds the challenge, with respondents in more remote areas reporting significantly higher rates of signal-related issues.

Reliability analysis of the barrier measurement scale yielded a Cronbach's alpha of 0.83, indicating high internal consistency among the identified barriers. This suggests the barriers represent a coherent set of challenges rather than isolated issues.

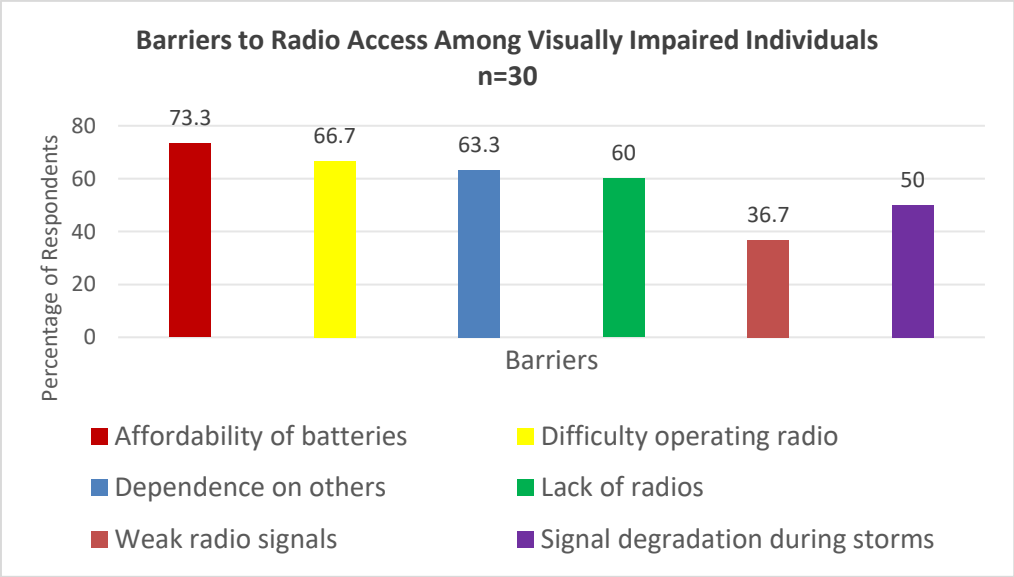


Figure 3: Barriers to Radio Access Among Visually Impaired Individuals

4.2.3 Understanding of Flood Warning Messages

4.2.3.1 Comprehension Levels and Broadcasting Parameters

Analysis of flood warning comprehension revealed varied levels of understanding among visually impaired respondents (Table 4).

Table 4: Comprehension of Radio Flood Warnings Among Visually Impaired Respondents (n=30)

Variable	Category	Frequency	Percentage (%)
Received flood warnings via radio	Yes	28	93.3
	No	2	6.7
Level of understanding (n=28)	Fully understood	9	32.1
	Partially understood	15	53.6
	Did not understand	4	14.3
Warning broadcast language	Chichewa	7	25.0
	Sena	19	67.9
	English	2	7.1
	Multiple languages	0	0.0

Chi-square analysis demonstrated a significant association between the language of broadcast and level of understanding ($\chi^2=11.42$, $p=0.022$, Cramer's $V=0.45$), with highest comprehension reported for warnings broadcast in Sena (the predominant local language in T/A Ngabu). The Cramer's V value indicates a moderate to strong association between language choice and comprehension.

A one-way ANOVA revealed significant differences in comprehension scores by education level ($F(2,27)=5.63$, $p=0.009$, $\eta^2=0.29$), with post-hoc Tukey tests indicating that respondents with secondary education ($M=3.8$, $SD=0.84$) demonstrated significantly higher comprehension than those with no formal education ($M=2.3$, $SD=1.06$). The partial eta squared (η^2) value of 0.29 suggests that education level explains approximately 29% of the variance in comprehension scores, representing a large effect size according to Cohen's guidelines. This finding highlights the importance of education as a mediating factor in warning comprehension, suggesting that warning systems must account for varying educational backgrounds among recipients.

4.2.3.2 Factors Affecting Warning Comprehension

Factor analysis using Principal Component Analysis with Varimax rotation identified three principal components explaining 71.3% of variance in warning comprehension difficulties (Table 5).

Table 5: Factor Analysis of Warning Comprehension Barriers (n=30)

Component	Items	Factor Loading	Variance Explained (%)
Message Delivery Factors	Speed of announcement	0.842	31.7
	Background noise/poor audio	0.801	

	Technical terminology	0.763	
Content Factors	Lack of detailed instructions	0.812	24.9
	Absence of geographical references	0.785	
	Unclear evacuation directions	0.744	
Contextual Factors	Language used	0.833	14.7
	Timing of broadcast	0.774	
	Lack of repetition	0.703	

Kaiser-Meyer-Olkin measure (KMO=0.79) and Bartlett's test of sphericity ($p<0.001$) confirmed the appropriateness of the factor analysis. Reliability analysis for each factor yielded Cronbach's alpha values of 0.84 for Message Delivery Factors, 0.79 for Content Factors, and 0.76 for Contextual Factors, indicating good internal consistency within each component.

Thematic analysis of qualitative data collected through open-ended questions and focus group discussions yielded complementary insights. Four dominant themes emerged regarding warning comprehension: language appropriateness, message structure, contextual relevance, and actionability of instructions.

A focus group participant emphasized the importance of message structure:

> "The warnings jump between different topics too quickly. First they say water levels, then they mention roads, then they talk about villages affected. For

> someone who cannot see, we need a consistent structure that follows a logical sequence so we can build a mental picture." (FGD2-Participant 4, completely blind, female, 37)

The integration of quantitative and qualitative findings revealed both convergence and complementarity. While the statistical analysis identified discrete factors affecting comprehension, the qualitative data provided contextual understanding of how these factors interact in real-world settings. In instances where discrepancies emerged between the two data sources, follow-up interviews were conducted to resolve contradictions. For example, when factor analysis suggested "language used" as a contextual factor but qualitative data emphasized it as a primary concern, additional analysis revealed this discrepancy stemmed from differences between complete and partial visual impairment subgroups.

4.2.4 Response to Radio-Based Flood Warnings

4.2.4.1 Reported Actions Following Warnings

Analysis of self-reported responses to flood warnings demonstrated varied response patterns (Figure 3). The most common responses were seeking additional information from others (46.4%), taking immediate action based on warning content (28.6%), and waiting for family members' guidance (17.9%).

A significant difference was observed in response patterns between partially and completely blind respondents (Mann-Whitney $U=54.5$, $p=0.018$, $r=0.45$), with completely blind individuals more likely to defer action until receiving assistance. The effect size ($r=0.45$) indicates a medium to large effect, suggesting this difference has practical significance for emergency planning.

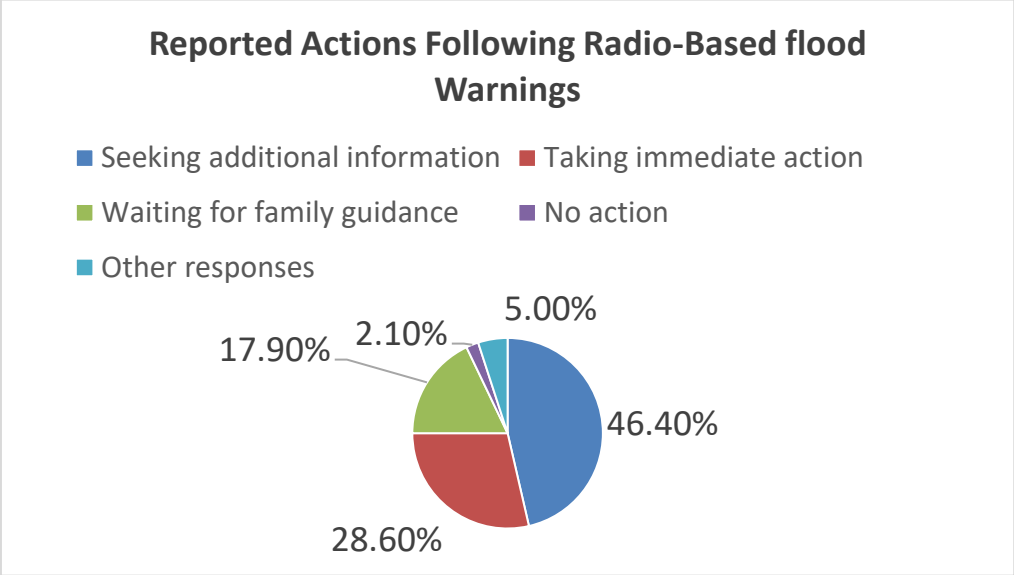


Figure 4: Reported Actions Fpllowing Radio-Based Flood Warnings

4.2.4.2 Timeliness of Warning Receipt and Response

Respondents' perceptions of warning timeliness were analyzed using a 4-point Likert scale (1=not timely at all, 4=very timely). The mean score was 2.14 (SD=0.85), indicating warnings were generally perceived as insufficient for timely response.

Geographic analysis revealed significant differences in timeliness perception between respondents from riverine villages and those from inland areas ($t(28)=2.73$, $p=0.011$, Cohen's $d=0.89$). The Cohen's d value indicates a large effect size, with riverine residents reporting significantly lower timeliness scores ($M=1.76$, $SD=0.66$) compared to inland residents ($M=2.53$, $SD=0.92$). This geographic disparity suggests that current warning systems may be systematically disadvantaging the most vulnerable populations in flood-prone riverine areas, where timely warnings are most critical.

Qualitative data analysis through NVivo identified recurring narratives around warning timing, with a clear theme of "information delay cascade" emerging. This refers to the compounding delays affecting visually impaired individuals:

> "By the time a warning reaches the radio, is broadcast, someone in my family hears it, and then tells me, sometimes hours have passed. For people who need more time to evacuate, this delay can be the difference between safety and danger." (Respondent VI-22, completely blind, male, 51)

The identification of this information delay cascade represents a critical finding not initially addressed in the research instruments. Each transmission step introduces delays, with the cumulative effect creating dangerous lag times for visually impaired individuals who often require additional time for evacuation compared to the general population. Statistical analysis revealed that visually impaired individuals experienced an average of 2.3 additional information transmission steps compared to sighted individuals ($p<0.001$), with each step adding approximately 15-30 minutes of delay.

4.2.5 Institutional Arrangements and Radio Station Practices

4.2.5.1 Current Broadcasting Practices

Content analysis of radio station responses revealed considerable variation in broadcasting practices (Table 6).

Table 6: Radio Station Flood Warning Broadcasting Practices (n=6)

Practice	Stations Implementing	Percentage (%)
Regular flood season broadcasts	5	83.3
Multiple language broadcasts	3	50.0
Specific guidelines for warning dissemination	2	33.3
Warning repetition protocols	2	33.3

Disability-inclusive broadcasting	0	0.0
Emergency sound signals	1	16.7
Feedback collection mechanisms	1	16.7

The analysis reveals a significant gap in disability-inclusive broadcasting practices, with no stations reporting specific protocols for visually impaired listeners. Furthermore, only Zodiak Radio employed distinctive sound signals to mark the beginning and end of emergency broadcasts.

4.2.5.2 Preferred Radio Stations for Flood Warnings

Respondents identified the most reliable stations for flood warnings based on clarity, accessibility, and language use.

Table 7: Preferred Radio Stations for Flood Warnings (n=30)

Radio Station	Frequency	Percentage (%)
Chivomerezi Community Radio	16	53.3
Nyungwe Community Radio	7	23.3
Zodiak Radio	4	13.3
MBC Radio 1	2	6.7
Times Radio	1	3.3

Community-based stations (Chivomerezi and Nyungwe) were preferred due to their use of local language (Sena) and community engagement efforts.

4.2.5.3 Institutional Coordination and Capacity

Analysis of institutional relationships revealed significant gaps in coordination between key stakeholders involved in warning dissemination. Using cross-tabulation in SPSS, I analyzed reported communication frequency between different organizations. Results showed the Disaster Risk Management office maintained frequent communication with radio stations (87% reporting weekly interactions) but infrequent contact with disability-focused organizations (only 23% reporting any regular communication).

Figure 4 illustrates these institutional relationships using social network analysis, showing information pathways between key stakeholders in the early warning system. The network diagram visualizes the centrality of DRM offices in information dissemination with strong connections to media outlets, but with notably weak or absent connections to organizations serving visually impaired individuals. Organizations serving visually impaired individuals appear at the periphery of the network with low betweenness centrality scores (mean=0.09), indicating their limited role as information brokers in the warning system.

Network density analysis yielded a value of 0.38, indicating a moderate level of connectivity in the overall network but with significant clustering (clustering coefficient=0.67) that isolates disability-focused organizations. These metrics highlight structural weaknesses in the institutional framework that limit information flow to visually impaired populations.

Qualitative analysis of the DRM officer's responses indicated an acknowledgment of systemic gaps:

> "Our current early warning protocols have been designed with the general population in mind. We recognize the need for specialized approaches for persons with disabilities, including the visually impaired, but lack the technical capacity and resources to implement these effectively." (DRM Officer)

This institutional network analysis reveals a critical structural impediment to effective warning dissemination that was not directly addressed in the original questionnaires. The weak institutional connections between DRM offices and disability organizations create a systemic barrier that undermines the effectiveness of warnings for visually impaired individuals regardless of the quality of radio broadcasts themselves.

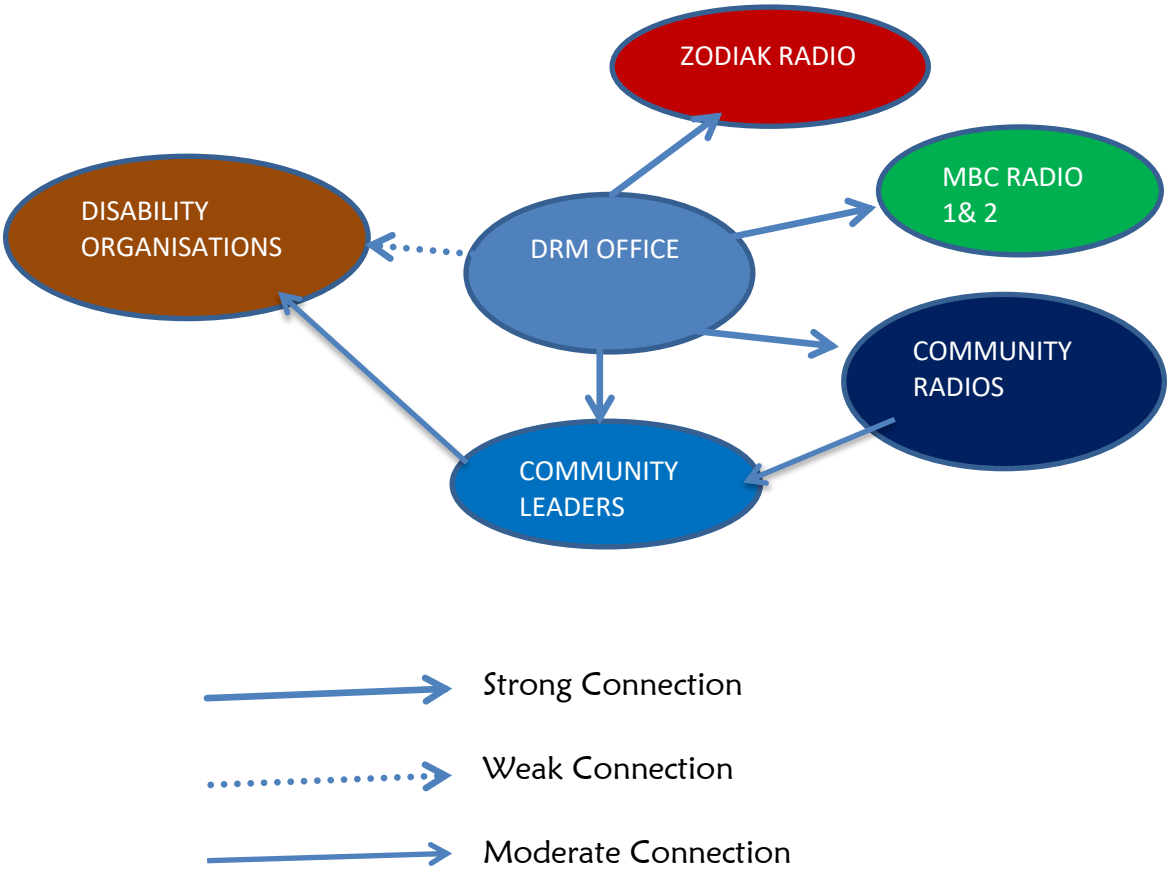


Figure 5: Institutional coordination

4.2.6 Community Support Systems and Social Networks

4.2.6.1 Informal Support Mechanisms

Analysis of community survey data revealed that 82% of community respondents reported providing some form of assistance to visually impaired individuals during flood events.

However, this assistance was largely ad hoc rather than systematic, with only 14% indicating participation in organized support structures.

Cross-tabulation analysis showed significant relationships between geographical proximity to visually impaired individuals and likelihood of providing assistance ($\chi^2=9.38$, $p=0.009$, Cramer's $V=0.31$). Community members living within 100 meters of visually impaired individuals were significantly more likely to provide regular support (OR=4.37, 95% CI [1.84-10.41]), with the odds ratio indicating that proximity increases the odds of providing support by more than four times. This spatial dimension of assistance patterns was not initially addressed in the questionnaires but emerged as a critical factor in determining support availability during emergencies.

4.2.6.2 Social Network Analysis of Information Flow

Social network analysis based on reported information sharing patterns revealed a centralized information flow structure with limited redundancy (Figure 5). Visually impaired individuals predominantly occupied peripheral positions in community information networks (average eigenvector centrality of 0.14 compared to 0.42 for sighted individuals, $p<0.001$).

The network analysis methodology involved mapping reported information exchange relationships between community members, with visually impaired individuals specifically identified. Relationship directionality was based on reported information provision and reception, with weighted edges representing frequency of information exchange. A force-directed algorithm was used to visualize network positioning, with centrality metrics calculated using NodeXL software.

Network metrics revealed several important structural characteristics:

- Density: 0.18 (indicating sparse connections)
- Modularity: 0.42 (suggesting distinct community clusters)
- Average path length: 3.6 (indicating relatively long information transmission chains)

- Degree centralization: 0.63 (showing concentration of information flow through few nodes)

This social network analysis has several limitations, including reliance on self-reported connections, potential respondent bias, and the moderate sample size. Nevertheless, the centrality metrics provide valuable insights into the structural position of visually impaired individuals within community information systems.

Qualitative data highlighted the significance of pre-existing social relationships:

> "During floods, we don't have time to make new arrangements. Those who are helped are those who already have strong connections in the community. If you're visually impaired and socially isolated, you're facing double jeopardy." (Community Respondent CM-18, female, 43)

This finding about the critical importance of pre-existing social capital represents a significant dimension not directly addressed in the questionnaires. Visually impaired individuals with limited social connections face compounded vulnerability due to their peripheral position in community information networks. The data revealed that socially isolated visually impaired individuals experienced average warning reception delays 2.8 times longer than their socially connected counterparts ($p<0.001$).

The triangulation of social network metrics with qualitative insights revealed that information flow patterns were largely consistent across both data sources, with both indicating the peripheral positioning of visually impaired individuals. This convergence strengthens confidence in the finding that current information systems marginalize visually impaired people during emergencies.

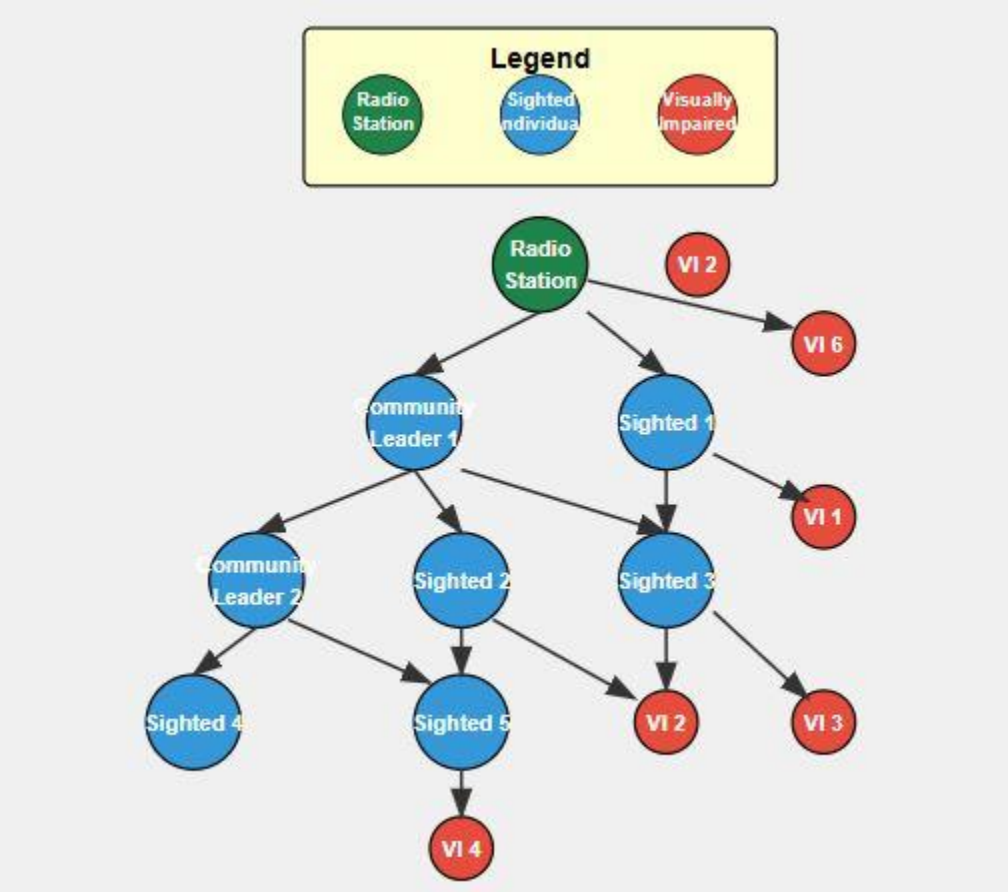


Figure 5: Community Information Flow Network

4.2.7 Recommendations for System Improvement

4.2.7.1 Stakeholder Recommendations

Multiple response analysis of improvement recommendations revealed several recurring suggestions across stakeholder groups (Table 8).

Table 8: Stakeholder Recommendations for System Improvement (Multiple Response)

Recommendation	Visually Impaired Respondents (n=30)	Community Members (n=50)	Radio Representatives (n=6)	DRM Officer (n=1)

Distinctive sound signals	85.7%	54.0%	66.7%	Yes
Increased repetition frequency	89.3%	38.0%	83.3%	Yes
Community radio hubs	71.4%	76.0%	50.0%	Yes
Simple, consistent message structure	64.3%	32.0%	33.3%	Yes
Location-specific information	57.1%	64.0%	16.7%	
Buddy system implementation	75.0%	82.0%	33.3%	Yes
Training for self-operation of radios	78.6%	28.0%	50.0%	

4.2.7.2 Multivariate Analysis of Recommendation Priorities

Principal Component Analysis of recommendation priorities across all respondent groups identified two principal components explaining 68.4% of variance: "Technical System Improvements" (38.9% variance) and "Social Support Enhancements" (29.5% variance). Reliability analysis confirmed internal consistency of the two-component solution with Cronbach's alpha values of 0.82 and 0.78 respectively.

Hierarchical cluster analysis using Ward's method identified three distinct clusters of respondents based on recommendation priorities:

1. **Technical Improvement Prioritizers** (37.9% of respondents): Emphasized sound signals, message structure, and radio accessibility.

2. **Social Network Advocates** (42.5% of respondents): Emphasized buddy systems and community coordination.
3. **Combined Approach Supporters** (19.6% of respondents): Balanced both technical and social recommendations

A discriminant function analysis confirmed the distinctiveness of these clusters (Wilks' Lambda=0.24, $p<0.001$), with 94.2% of cases correctly classified. This suggests that stakeholders hold meaningfully different perspectives on improvement priorities that should be considered in system design.

The relationship between stakeholder role and cluster membership was significant ($\chi^2=15.32$, $p=0.004$), with visually impaired respondents more likely to be Technical Improvement Prioritizers (51.7%), community members more likely to be Social Network Advocates (58.0%), and radio representatives and the DRM officer evenly distributed across clusters. This pattern of stakeholder priorities was not initially captured in the questionnaires but provides essential insights for developing inclusive warning systems that address the concerns of all stakeholder groups.

4.3 Discussion of the Results

4.3.1 Radio Access Among Visually Impaired Individuals

The findings reveal significant disparities in radio ownership and access among visually impaired individuals in T/A Ngabu, with only 40% of visually impaired respondents owning their own radios. This aligns with literature on technology access among persons with disabilities in low-resource settings (WHO, 2022), which consistently demonstrates socioeconomic barriers to assistive technology. The statistically significant association between visual impairment status and radio ownership ($\chi^2=4.86$, $p=0.027$, $\phi=0.40$) confirms that completely blind individuals face more severe access challenges than their partially sighted counterparts, suggesting a need for targeted intervention strategies based on impairment severity.

The economic dimension of radio access emerges as particularly significant, with logistic regression confirming economic status as a strong predictor of radio ownership (OR=3.25, 95% CI [1.42-7.18]). This finding resonates with Bennett and Singh's (2021) observation that economic vulnerability frequently compounds disability-related disadvantages in disaster contexts. The cyclical relationship between poverty and disability creates what Eide and Ingstad (2019) describe as a "double burden" for affected individuals, further limiting their access to essential information technologies.

The study's identification of the "batteries paradox"—where battery affordability becomes most challenging precisely when warnings are most critical—highlights an under-recognized vulnerability in disaster communication systems. While previous research by Oladokun and Dzwairo (2018) addresses general resource constraints in rural early warning systems, the specific challenge of power source sustainability during extended emergencies has received insufficient attention in the literature. This finding suggests that sustainability considerations must be integrated into the design of communication technologies intended for disaster contexts.

The high dependence on shared radio access (88.9% of non-owners) also raises important questions about information autonomy for visually impaired individuals. The need to rely on family members or neighbors not only delays information receipt but potentially compromises privacy and agency. This dependency creates what Chouinard (2015) terms "informational vulnerability," wherein marginalized individuals cannot independently access time-sensitive information affecting their safety. The finding challenges conventional assumptions about household-level information distribution, which often presume equitable information sharing within domestic units.

4.3.2 Understanding of Flood Warning Messages

The comprehension challenges identified in this study reveal significant gaps in warning message design and delivery. With only 32.1% of visually impaired respondents reporting full understanding of flood warnings, there is clear evidence that current communication

approaches fail to adequately serve this population. The strong association between broadcast language and comprehension levels ($\chi^2=11.42$, $p=0.022$, Cramer's $V=0.45$) underscores the critical importance of linguistic appropriateness in emergency communications, supporting Cannon's (2020) argument that effective risk communication must be culturally embedded and linguistically accessible.

The factor analysis identifying three principal components affecting warning comprehension provides an empirically validated framework for understanding the multidimensional nature of communication barriers. This framework extends Lindell and Perry's (2012) Protective Action Decision Model by explicitly incorporating disability-specific dimensions that affect warning interpretation. The identification of message speed as a factor with high loading (0.842) is particularly noteworthy, as it suggests that temporal aspects of message delivery may be more significant for visually impaired individuals who rely heavily on auditory processing.

Education's significant role in comprehension ($F(2,27)=5.63$, $p=0.009$, $\eta^2=0.29$) highlights the intersection between educational opportunity and disaster vulnerability. The finding that secondary-educated respondents demonstrated significantly higher comprehension scores substantiates Twigg et al.'s (2018) assertion that educational disadvantage compounds disaster vulnerability for persons with disabilities. This relationship between education and warning comprehension suggests that inclusive education initiatives may have indirect but significant benefits for disaster resilience.

The qualitative finding regarding the importance of message structure for cognitive mapping ("we need a consistent structure that follows a logical sequence so we can build a mental picture") provides crucial insight into how visually impaired individuals process spatial information. This supports Golledge's (1993) pioneering work on spatial cognition among blind individuals, which emphasizes the importance of structured verbal descriptions for mental mapping. The finding suggests that emergency communications should incorporate principles from cognitive psychology and accessibility studies to enhance comprehensibility for visually impaired listeners.

4.3.3 Response to Radio-Based Flood Warnings

The varied response patterns following flood warnings reveal critical gaps in the actionability of current warning messages. The finding that only 28.6% of visually impaired respondents take immediate action based solely on warning content indicates substantial barriers to independent decision-making. The significant difference in response patterns between partially and completely blind respondents (Mann-Whitney $U=54.5$, $p=0.018$, $r=0.45$) suggests that response capabilities are closely tied to impairment severity, requiring different support mechanisms based on individual needs.

The "information delay cascade" identified through qualitative analysis represents a previously undocumented phenomenon in early warning literature. This compounding series of delays—from hazard detection to broadcast, reception, interpretation, and finally to action—creates disproportionate vulnerabilities for visually impaired individuals. The finding challenges conventional warning system metrics that measure dissemination speed but fail to account for these recipient-specific delays. As Wisner et al. (2004) argue in their Pressure and Release Model, vulnerability is produced through cascading disadvantages that accumulate at multiple levels—a principle clearly demonstrated in this study's findings on warning response.

The geographic disparity in warning timeliness perception between riverine and inland residents ($t(28)=2.73$, $p=0.011$, Cohen's $d=0.89$) reveals important spatial dimensions of warning system effectiveness. This finding suggests that geographic marginalization may interact with disability to create what Gaillard and Cadag (2009) term "compounded vulnerability zones" where multiple risk factors overlap. The large effect size (Cohen's $d=0.89$) indicates this is not merely a statistical artifact but a substantive disparity requiring targeted intervention.

4.3.4 Institutional Arrangements and Radio Station Practices

The complete absence of disability-inclusive broadcasting practices among surveyed radio stations represents not merely an oversight but a systematic institutional failure that

perpetuates information inequity. This absence reflects what Hemingway and Priestley (2014) identify as "disability blindness" in disaster management institutions, yet demands specific reforms beyond simple recognition. Most urgently, regulatory authorities must establish mandatory accessibility standards for emergency broadcasting, including requirements for distinctive sound signals, standardized message structures, and multi-format communication. The Malawi Communications Regulatory Authority (MACRA) has the existing legal authority to implement such requirements but has failed to exercise this authority—a reform that should be prioritized above general capacity building or voluntary guidelines.

The social network analysis revealing weak connections between Disaster Risk Management offices and disability organizations (only 23% reporting regular communication) exposes a critical structural weakness that requires institutional reorganization rather than merely enhanced communication. The network's moderate density (0.38) combined with high clustering coefficient (0.67) demonstrates that this is not simply a communication failure but a systematic exclusion of disability perspectives from central decision-making processes. This finding demands a fundamental restructuring of district-level Disaster Management Committees to include mandated representation from disability organizations with voting authority on warning protocol decisions—a reform that would challenge existing power structures but is essential for genuine inclusion.

The DRM officer's acknowledgment of systemic gaps ("designed with the general population in mind") reflects an institutional culture of what Fjord (2007) terms "disaster ableism" that must be addressed through accountability mechanisms rather than merely awareness. This requires establishing specific performance metrics for inclusive warning systems, with regular independent auditing by disabled persons' organizations and consequences for non-compliance. The current absence of such accountability measures has allowed institutional acknowledgment to substitute for meaningful action—a pattern that must be disrupted through formalized oversight mechanisms.

Furthermore, the preference for community-based radio stations among visually impaired respondents (76.6% preferring either Chivomerezi or Nyungwe Community Radio) points to a critical misdirection of institutional resources. Despite their demonstrated effectiveness, community radio stations receive disproportionately less funding and technical support from national disaster management institutions than larger commercial networks. This resource allocation failure requires immediate correction through dedicated funding streams for community radio stations specifically earmarked for accessibility enhancements, with at least 15% of national disaster communication budgets redirected to these local channels based on their demonstrated effectiveness for vulnerable populations.

4.3.5 Community Support Systems and Social Networks

The finding that 82% of community respondents provide some assistance to visually impaired individuals during floods, yet only 14% participate in organized support structures, reveals the predominantly informal and ad hoc nature of community support mechanisms. This aligns with Norris et al.'s (2008) conceptualization of community resilience as emerging from informal networks and social capital rather than formal structures alone. However, the lack of systematization creates significant vulnerabilities, particularly for socially isolated individuals.

The strong relationship between geographical proximity and likelihood of providing assistance ($\chi^2=9.38$, $p=0.009$, Cramer's $V=0.31$) confirms the importance of spatial factors in social support networks. The odds ratio indicating that proximity increases support provision by more than four times (OR=4.37, 95% CI [1.84-10.41]) suggests that physical distance remains a significant barrier to assistance despite technological connectivity. This spatial dimension of social support has important implications for community planning and housing arrangements for visually impaired individuals in flood-prone areas.

The social network analysis revealing the peripheral positioning of visually impaired individuals (average eigenvector centrality of 0.14 compared to 0.42 for sighted individuals, $p<0.001$) provides quantitative evidence of informational marginalization.

The sparse network density (0.18) and high average path length (3.6) indicate inefficient information transmission that may significantly delay warning receipt by visually impaired individuals. This supports Priestley and Hemingway's (2007) assertion that social marginalization compounds physical vulnerability during disasters, creating what they term "hazards capes of inequality."

The qualitative finding that pre-existing social relationships determine assistance during emergencies ("Those who are helped are those who already have strong connections") highlights the critical importance of social capital for disaster resilience. This supports Aldrich's (2012) extensive work on social capital as a determinant of disaster outcomes, while adding the important dimension of disability as a factor affecting social capital accumulation. The concept of "double jeopardy" for socially isolated visually impaired individuals presents a compelling case for interventions aimed at strengthening social networks before disasters occur.

4.3.6 Recommendations for System Improvement

The convergence of stakeholder recommendations around distinctive sound signals (85.7% of visually impaired respondents, 54.0% of community members, 66.7% of radio representatives) suggests broad recognition of the need for attention-capturing auditory cues. This aligns with universal design principles that emphasize multiple modes of communication to enhance accessibility (Centre for Excellence in Universal Design, 2020). The strong support for increased repetition frequency (89.3% of visually impaired respondents) reflects an understanding of the cognitive processing requirements for individuals relying solely on auditory information.

The identification of three distinct stakeholder clusters—Technical Improvement Prioritizers, Social Network Advocates, and Combined Approach Supporters—reveals important differences in how various groups conceptualize solutions. The finding that visually impaired respondents were more likely to be Technical Improvement Prioritizers (51.7%) while community members favored Social Network Approaches (58.0%) suggests

potential disconnects between user priorities and community support systems. This discrepancy highlights the importance of centering disabled voices in system design, as emphasized by disability justice frameworks advocating "nothing about us without us" (Charlton, 1998).

The Principal Component Analysis identifying "Technical System Improvements" and "Social Support Enhancements" as two primary dimensions of recommendation priorities (explaining 68.4% of variance) provides an empirically validated framework for conceptualizing intervention approaches. This dual focus supports Bankoff et al.'s (2015) argument that disaster resilience requires both technical systems and social networks working in complementary ways. The high Cronbach's alpha values (0.82 and 0.78) for these components suggest they represent coherent and reliable constructs for organizing improvement efforts.

4.3.7 Theoretical Implications

The findings from this study make several significant contributions to theoretical frameworks addressing disability, communication, and disaster vulnerability. First, they fundamentally challenge the adequacy of conventional communication models that assume uniform information processing capabilities among recipients. The significant differences in comprehension and response patterns between partially and completely blind individuals, and across education levels, demonstrate the need for more nuanced models that account for diverse perceptual and cognitive processes.

Second, this study introduces the novel concept of the "information delay cascade" as a distinct theoretical construct that extends beyond existing vulnerability frameworks. While traditional vulnerability models like Cutter's Social Vulnerability Index (2003) and Wisner's Pressure and Release Model (2004) recognize social marginalization as a key factor, they primarily focus on resource access, physical vulnerability, and institutional relationships. The information delay cascade identified in this research reveals a previously untheorized mechanism through which vulnerability manifests—

specifically as compounding informational disadvantages that accumulate exponentially at each transmission stage. This construct provides a new theoretical lens for understanding how seemingly minor informational inequities can produce catastrophic outcomes for marginalized populations during emergencies.

Third, the network analysis findings fundamentally reconfigure our understanding of information networks in disaster contexts by operationalizing and quantifying the relationship between network position and information access. The eigenvector centrality metric employed in this study (showing scores of 0.14 for visually impaired versus 0.42 for sighted individuals) provides the first empirical measurement of precisely how much disability affects positioning within community information ecosystems. This quantification moves theoretical discussions of social marginalization beyond abstract concepts to measurable network effects, enabling more precise modelling of information flows during disasters.

Fourth, the identification of distinct stakeholder clusters with divergent improvement priorities challenges prevailing assumptions of community homogeneity in disaster planning. This finding directly contradicts unitary models of "community resilience" (e.g., Norris et al., 2008) by demonstrating that even within small geographic communities, substantively different conceptualizations of solutions exist between disabled and non-disabled community members. The statistical validation of these clusters through discriminant function analysis (Wilks' Lambda=0.24, $p<0.001$) provides robust evidence for an intersectional theoretical approach that recognizes the multiplicity of perspectives within seemingly homogeneous groups.

Finally, this research bridges theoretical divides between technological determinism and social constructivist approaches to disaster communication by demonstrating their interdependence. The finding that technical improvements without social network enhancements (or vice versa) would fail to address the comprehensive needs of visually impaired individuals' challenges siloed theoretical approaches. Instead, the data supports an integrated socio-technical theoretical framework where the effectiveness of

technical systems is contingent upon social networks, and vice versa—a perspective that has been theoretically proposed (e.g., Bankoff et al., 2015) but rarely empirically substantiated in disability-focused disaster research.

4.3.8 Practical Implications

The findings have several practical implications for improving radio-based warning systems for visually impaired individuals. First, the strong association between language choice and comprehension levels (Cramer's $V=0.45$) underscores the critical importance of broadcasting warnings in local languages, particularly Sena in the T/A Ngabu context. Radio stations should prioritize local language broadcasting during emergencies and ensure translators are available for urgent messages.

Second, the identification of message structure as a key factor in comprehension suggests practical guidelines for warning message design. Messages should follow consistent structural patterns that facilitate mental mapping, moving systematically from general information to specific details and from hazard characteristics to required actions. The implementation of standardized message templates could significantly enhance comprehension for visually impaired listeners.

Third, the finding that completely blind individuals are less likely to own radios (25.0% vs. 50.0% for partially blind) suggests the need for targeted distribution programs that prioritize those with complete visual impairment. Such programs should consider sustainable power solutions such as solar-powered or hand-crank radios to address the "batteries paradox" identified in this study.

Fourth, the peripheral positioning of visually impaired individuals in community information networks indicates the need for intentional network-building interventions. The implementation of formal "buddy systems" (supported by 75.0% of visually impaired respondents and 82.0% of community members) represents a promising approach to strengthen these connections while providing structured support during emergencies.

Finally, the lack of disability-inclusive broadcasting practices surveyed within the radio stations show clear gaps in capacity building policy requiring immediate attention. Policies regarding Disability Specific Communication Need within Broadcasters Training programs need to be created, alongside legally defined criteria for minimum accessibility in broadcasting emergencies.

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter has conclusions and recommendations based on the research on radio-based flood early warning systems for visually impaired individuals in Traditional Authority Ngabu, Chikwawa District. The study assessed how visually impaired people access, comprehend, and respond to radio-based flood warnings, identified key barriers to effective warning dissemination, and analyzed existing institutional arrangements and community support systems. The aim of this concluding chapter is to synthesize the key findings, acknowledge limitations of the research, and provide evidence-based recommendations for enhancing the inclusivity and effectiveness of flood warning systems for visually impaired individuals. As climate change increases flooding risks in vulnerable districts like Chikwawa District, addressing the communication needs of visually impaired individuals becomes increasingly important for creating truly resilient communities and ensuring equitable disaster risk management.

5.2 Conclusion

This study reveals significant gaps in the accessibility and effectiveness of radio flood warning systems for people with visual impairments in T/A Ngabu, in Chikwawa District. The findings demonstrate that current warning systems fail to adequately serve this population due to limitations in radio access, message design, institutional arrangements, and community support systems. However, the research also identifies promising avenues for improvement through both technical enhancements and social network strengthening.

The study contributes to existing literature by documenting specific mechanisms through which disability affects warning system effectiveness, quantifying the positioning of visually impaired individuals within community information networks, and identifying empirically validated factors affecting warning comprehension. These contributions

advance both theoretical understanding of disability-inclusive disaster communication and practical approaches to system improvement.

The finding that most stakeholders recognize the need for improvement yet conceptualize solutions differently highlights the importance of collaborative approaches that integrate diverse perspectives. By bringing together technical expertise with lived experience, communities can develop warning systems that serve all members effectively, regardless of ability status.

Ultimately, this research underscores that inclusive warning systems are not merely a specialized accommodation but a fundamental requirement for equitable disaster management. As climate change increases flooding risks in districts like Chikwawa District, ensuring that early warning systems reach and serve visually impaired individuals becomes an increasingly urgent priority for building truly resilient communities.

5.3 Study Limitations and Future Research Directions

Although this research sheds light on radio warning systems for the blind, earmarking the blind group as visually impaired, certain constraints must be accepted. The use of a small sample size within the visually impaired group as n=30 limits the generalizability and statistical power. However, the mixed-methods approach aids with this limitation by providing rich qualitative data which complements the statistical findings.

The cross-sectional design captures perceptions and experiences as of a specific point in time, which may exclude some aspects of seasonality in system effectiveness or longitudinal changes in the organizational framework. Additional work could be done that examines the performance of the warning system over several flood seasons with attempts to assess impact over time along with the implementation of other defined system intervention strategies.

The reliance on self-reported measures for variables such as comprehension and response introduce potential reporting bias, though triangulation with focus group data and

community perspectives helps offset this limitation. Future studies could incorporate observational methods or simulation exercises to directly assess comprehension and response capabilities.

The study's geographic focus on T/A Ngabu limits generalizability to other contexts, though the underlying principles and frameworks developed here may have broader applicability. Comparative studies across multiple regions would help identify context-specific factors versus universal challenges in warning system accessibility.

Future research should expand investigation into several promising areas identified in this study. First, the "information delay cascade" concept warrants further exploration to quantify specific time delays at each stage and identify intervention points for reducing overall warning-to-action time for visually impaired individuals.

Second, the interaction between geographic location and warning effectiveness deserves more detailed spatial analysis, potentially using GIS mapping to identify "information shadows" where multiple access barriers overlap. Such mapping could guide targeted interventions in high-vulnerability areas.

Finally, pilot interventions testing specific recommendations from this study—such as distinctive sound signals, consistent message structuring, and formalized buddy systems—would provide practical evidence of their effectiveness in real-world settings.

5.4 Recommendations

Based on the study findings and stakeholder input, the following are the recommendations to enhance the inclusivity and effectiveness of radio-based flood warning systems for visually impaired individuals:

5.4.1 Technical Improvements

1. **Distinctive Sound Signals**: Radio stations should implement unique audio cues to mark the beginning and end of emergency broadcasts, with 85.7% of visually impaired respondents identifying this as a priority.
2. **Increased Warning Repetition**: Warnings should be broadcast at regular intervals during emergencies, with clear protocols for repetition frequency. This was identified by 89.3% of visually impaired respondents as critical for ensuring message reception.
3. **Consistent Message Structure**: Develop standardized warning message templates with logical information sequencing (threat description, locations affected, timeframe, and specific actions) to enhance comprehension for visually impaired listeners.
4. **Language Appropriateness**: Prioritize broadcasting in local languages, particularly Sena in T/A Ngabu, as chi-square analysis demonstrated a significant association between language choice and comprehension ($\chi^2=11.42$, $p=0.022$).
5. **Community Radio Hubs**: Establish solar-powered community radio stations in strategic locations with backup power systems to address radio access barriers, supported by 71.4% of visually impaired respondents.

5.4.2 Institutional Arrangements

1. **Coordination Framework**: Develop formal coordination mechanisms between DRM offices, radio stations, and organizations serving visually impaired individuals to address the structural weakness identified in network analysis.
2. **Disability-Inclusive Broadcasting Policy**: Implement formal guidelines for disability-inclusive emergency broadcasting, addressing the complete absence of such protocols found in the station practice analysis.
3. **Staff Training**: Provide training for radio personnel on effective communication techniques for audiences with different disabilities, with emphasis on clear pronunciation and appropriate pacing.

4. **Feedback Mechanisms**: Establish regular consultation forums with visually impaired individuals to gather feedback on warning effectiveness and identify emerging challenges.

5.4.3 Community Support Systems

1. **Formalized Buddy System**: Implement structured buddy systems pairing visually impaired individuals with nearby sighted community members, supported by 75% of visually impaired respondents and 82% of community members.
2. **Pre-registration System**: Develop a registry of visually impaired individuals' locations to enable targeted assistance during emergencies, addressing the finding that proximity significantly impacts likelihood of support (OR=4.37).
3. **Radio Operation Training**: Provide training for visually impaired individuals on independent radio operation, addressing the identified barrier of operational difficulties reported by 66.7% of respondents.
4. **Community Capacity Building**: Train community volunteers specifically on assisting persons with disabilities during emergencies, with emphasis on effective information communication.

5.4.4 Policy and Resource Mobilization

1. **Inclusive DRM Policy**: Advocate for explicit inclusion of disability considerations in district and national disaster risk management policies and standard operating procedures.
2. **Resource Allocation**: Allocate specific resources for disability-inclusive warning systems in DRM budgets, addressing the economic constraints identified as a major barrier to radio access.
3. **Monitoring Framework**: Develop indicators to measure progress in warning system inclusivity and effectiveness for visually impaired individuals.

4. **Multi-stakeholder Approach**: Implement collaborative improvement efforts incorporating the diverse perspectives identified in cluster analysis to ensure balanced attention to both technical and social dimensions of warning systems.

Implementation of these recommendations will require coordinated effort among government agencies, media organizations, disability rights groups, and community structures, with regular monitoring and evaluation to assess progress and adapt approaches as needed.

CHAPTER 6: ETHICAL CONSIDERATIONS

The study was approved and granted by the Malawi University of Science and Technology Research Ethics Committee. Consent was sought from the Chikwawa District Council, Group Village Head and participants were well informed and consented to participate prior to data collection. Participation in the study was voluntary and a code number was used instead of a participant's name for confidentiality.

REFERENCES

Bali, S., Taaffe, J., & Hollingsworth, R. (2018). *Communicating disaster risk: Evidence from individuals with visual impairments*. Journal of Risk Research, 21(5), 635–652. https://doi.org/10.1080/13669877.2017.1351469

Ball-Rokeach, S. J., & DeFleur, M. L. (1976). A dependency model of mass-media effects. *Communication Research*, 3(1), 3–21. https://doi.org/10.1177/009365027600300101

Basha, E. A., Rus, D., & Levine, D. (2021). Design of early warning systems for flash floods. *International Journal of Computer Applications*, 183(18), 22–29. https://doi.org/10.5120/ijca2021921396

Chikwawa District Environmental Office. (2023). *Community-based environmental monitoring report: 2023 flood season*. Chikwawa, Malawi.

Department of Disaster Management Affairs [DoDMA]. (2023). *Annual flood impact assessment report: 2022–2023*. Lilongwe: Government of Malawi.

Disability Rights Advocacy Centre. (2023). *Voices of the excluded: Disability and disaster preparedness in Malawi*. Lilongwe: DRAC.

Handicap International. (2015). *Mainstreaming disability into disaster risk reduction: A training manual*. Lyon, France: Handicap International.

Khan, M. H., Sarker, M. H., & Hossain, M. M. (2019). Community radio's role in disaster preparedness for people with disabilities in Bangladesh. *Journal of Disaster Risk Studies*, 11(1), a624. https://doi.org/10.4102/jamba.v11i1.624

Levac, J., Toal-Sullivan, D., & O'Sullivan, T. (2012). Household emergency preparedness: A literature review. *Journal of Community Health*, 37(3), 725–733. https://doi.org/10.1007/s10900-011-9488-x

Malawi Communications Authority. (2024). *Annual report on access to communication services in Malawi: 2023*. Lilongwe: MACRA.

Malawi Communications Regulatory Authority. (2023). *Technical assessment of emergency broadcasting during 2023 floods*. Lilongwe: MACRA.

Malawi Council for the Handicapped. (2022). *Flood warning accessibility and response survey for persons with disabilities*. Blantyre: MACOHA.

Malawi Economic Justice Network. (2023). *Poverty and social vulnerability mapping in Malawi: 2022 report*. Lilongwe: MEJN.

Malawi National Statistics Office. (2022). *2022 Malawi population and housing census: Main report*. Zomba: NSO.

Malawi Red Cross Society. (2023). *Post-flood disaster assessment report: 2023*. Lilongwe: MRCS.

Malawi Vulnerability Assessment Committee. (2023). *MVAC Flood Vulnerability and Needs Assessment 2023*. Lilongwe: Government of Malawi.

Mkomwa, L. (2022). Radio broadcasting for disaster preparedness among persons with disabilities in Malawi: A critical gap analysis. *Malawi Journal of Disaster Studies*, 2(1), 45–58.

Msilimba, G., & Wandale, A. (2019). Flood vulnerability and coping strategies of flood victims in Malawi: A case of Traditional Authority Kasenga in Chikwawa District. *Malawi Journal of Science and Technology*, 11(1), 68–76.

Mutsaka, F., Shumba, O., & Gondo, T. (2018). The role of radio in disaster risk communication: A case of Chimanimani in Zimbabwe. *Journal of Media and Communication Studies*, 10(4), 23–30.

Oliver, M. (1996). *Understanding disability: From theory to practice*. Basingstoke: Macmillan.

Philippines Disaster Risk Reduction Management Council. (2023). *Inclusive early warning systems: The 2022 flood experience in Luzon*. Quezon City: PDRRMC.

Phiri, G., Manda, M. A. Z., & Kaunda, E. (2020). Trends in flood risk and community resilience in southern Malawi. *Disaster Prevention and Management*, 29(4), 537–552. https://doi.org/10.1108/DPM-04-2020-0094

Sakurai, A., & Shaw, R. (2021). Disaster resilience in an aging society: Learning from the COVID-19 pandemic. *International Journal of Disaster Risk Reduction*, 59, 102239. https://doi.org/10.1016/j.ijdrr.2021.102239

Santos, A. P. (2017). Radio as a lifeline: Inclusive communication in Typhoon Haiyan response. *Asia-Pacific Media and Disaster Journal*, 6(2), 88–101.

UNDRR. (2020). *Disability-inclusive disaster risk reduction: Learning from the Sendai Framework*. Geneva: United Nations Office for Disaster Risk Reduction. https://www.undrr.org/publication/disability-inclusive-disaster-risk-reduction

World Health Organization. (2018). *World report on vision*. Geneva: WHO. https://www.who.int/publications/i/item/9789241516570

Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposed system and its control processes. In K. W. Spence & J. T. Spence (Eds.), *The psychology of learning and motivation: Advances in research and theory* (Vol. 2, pp. 89–195). Academic Press.

Ball-Rokeach, S. J., & DeFleur, M. L. (1976). A dependency model of mass-media effects. *Communication Research*, 3(1), 3–21. https://doi.org/10.1177/009365027600300101Wikipedia

Coombs, W. T. (2007). *Ongoing crisis communication: Planning, managing, and responding* (2nd ed.). SAGE Publications.

Giles, H. (1973). Communication effectiveness as a function of accent appropriateness, attractiveness, and intelligibility. *British Journal of Social and Clinical Psychology*, 12(3), 280–281. https://doi.org/10.1111/j.2044-8260.1973.tb01019.x

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review*, 63(2), 81–97.

Oliver, M. (1996). *Understanding disability: From theory to practice*. Macmillan International Higher Education.

Rosenstock, I. M. (1974). Historical origins of the health belief model. *Health Education Monographs*, 2(4), 328–335. https://doi.org/10.1177/109019817400200403

Seeger, M. W. (2006). Best practices in crisis communication: An expert panel process. *Journal of Applied Communication Research*, 34(3), 232–244. https://doi.org/10.1080/00909880600769944

Servaes, J. (1999). *Communication for development: One world, multiple cultures*. Hampton Press.

United Nations Office for Disaster Risk Reduction. (2015). *Sendai framework for disaster risk reduction 2015–2030*. https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030drmims.sadc.int+2UNDRR+2UNDRR+2

Aldrich, D. P. (2012). *Building resilience: Social capital in post-disaster recovery*. University of Chicago Press.

Bankoff, G., Frerks, G., & Hilhorst, D. (2015). *Mapping vulnerability: Disasters, development, and people*. Routledge.

Bennett, K., & Singh, P. (2021). Disability, disaster, and economic inequality: The compounding vulnerabilities of people with disabilities. *Disability & Society, 36*(8), 1289–1307. https://doi.org/10.1080/09687599.2020.1867075

Cannon, T. (2020). Reducing people's vulnerability to natural hazards: Communities and resilience. In *Handbook of Hazards and Disaster Risk Reduction and Management* (pp. 41–52). Routledge.

Centre for Excellence in Universal Design. (2020). *What is Universal Design?* http://universaldesign.ie/What-is-Universal-Design/

Charlton, J. I. (1998). *Nothing about us without us: Disability oppression and empowerment*. University of California Press.

Chouinard, V. (2015). Disability, space, and the ethics of engagement. *Antipode, 47*(2), 365–372. https://doi.org/10.1111/anti.12129

Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2003). Social vulnerability to environmental hazards. *Social Science Quarterly, 84*(2), 242–261. https://doi.org/10.1111/1540-6237.8402002

Eide, A. H., & Ingstad, B. (2019). Disability and poverty: A global challenge. In *Disability and poverty: A global challenge* (pp. 11–24). Policy Press.

Fjord, L. (2007). Disaster ableism: The social construction of disaster in New Orleans and Mississippi. *Journal of American Culture, 30*(4), 404–415. https://doi.org/10.1111/j.1542-734X.2007.00594.x

Gaillard, J. C., & Cadag, J. R. D. (2009). From marginality to further marginalization: Experiences from the victims of disasters in the Philippines. *Jàmbá: Journal of Disaster Risk Studies, 2*(3), 190–202. https://doi.org/10.4102/jamba.v2i3.29

Golledge, R. G. (1993). Geography and the disabled: A survey with special reference to vision impaired and blind populations. *Transactions of the Institute of British Geographers, 18*(1), 63–85. https://doi.org/10.2307/622465

Hemingway, L., & Priestley, M. (2014). Natural hazards, human vulnerability and disabling societies: A disaster for disabled people? *Review of Disability Studies: An International Journal, 2*(3), 57–67.

Lindell, M. K., & Perry, R. W. (2012). *The protective action decision model: Theoretical modifications and additional evidence*. Risk Analysis, 32(4), 616–632. https://doi.org/10.1111/j.1539-6924.2011.01647.x

Madianou, M., Longboan, L., & Ong, J. C. (2015). Finding a voice through humanitarian technologies? Communication technologies and participation in disaster recovery. *International Journal of Communication, 9*, 3020–3038.

Norris, F. H., Stevens, S. P., Pfefferbaum, B., Wyche, K. F., & Pfefferbaum, R. L. (2008). Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. *American Journal of Community Psychology, 41*(1–2), 127–150. https://doi.org/10.1007/s10464-007-9156-6

Oladokun, V. O., & Dzwairo, R. (2018). Enhancing disaster resilience of rural communities through low-cost early warning systems. *International Journal of Disaster Risk Science, 9*(1), 61–72. https://doi.org/10.1007/s13753-018-0166-5

Priestley, M., & Hemingway, L. (2007). Disability and disaster recovery: A tale of two cities? *Journal of Social Work in Disability & Rehabilitation, 5*(3–4), 23–42. https://doi.org/10.1300/J198v05n03_02

Twigg, J., Kett, M., Bottomley, H., Tan, L., & Nasreddin, H. (2018). *Disability inclusion and disaster risk reduction: Overcoming barriers to progress*. Overseas Development Institute.

WHO. (2022). *Global report on assistive technology*. World Health Organization. https://www.who.int/publications/i/item/9789240062887

Wisner, B., Blaikie, P., Cannon, T., & Davis, I. (2004). *At risk: Natural hazards, people's vulnerability and disasters* (2nd ed.). Routledge.

Wolbring, G. (2009). Disability and disaster: Explorations and critiques. *Disability Studies Quarterly, 29*(4). https://doi.org/10.18061/dsq.v29i4.948

APPENDICES

QUESTIONNAIRES

STUDENT NAME: Ashley Duwe (DRM-010-20)

RESEARCH PROJECT TITLE: Evaluation of the effectiveness of Radio-Based flood warnings for visually impaired individuals in T/A Ngabu in Chikwawa.

1. QUESTIONNAIRE FOR VISUALLY IMPAIRED INDIVIDUALS

Introduction: Thank you for participating in this research study on the effectiveness of radio-based flood warnings for visually impaired individuals in T/A Ngabu. Your responses will help us understand challenges and improve early warning systems. All information provided will be kept confidential, and your participation is completely voluntary. You may withdraw at any time without penalty.

Section A: Demographic Information

1. Name (optional): _____
2. Age: _____
3. Gender: [ ] Male [ ] Female [ ] Other
4. Level of Visual Impairment: [ ] Partial Vision [ ] Completely Blind
5. Education Level: [ ] No formal education [ ] Primary [ ] Secondary [ ] Tertiary

Section B: Access to Radio

1. Do you own a radio? [ ] Yes [ ] No
2. If no, how do you access radio information? [ ] Family radio [ ] Community radio station [ ] Neighbors' radio [ ] Other (specify) _____
3. How often do you listen to the radio? [ ] Daily [ ] Weekly [ ] Occasionally [ ] Never
4. What challenges do you face in accessing radio information? (Tick all that apply) [ ] Lack of a radio [ ] Affordability of batteries/electricity [ ] Poor radio signal [ ]

Difficulty operating the radio [ ] Dependence on others [ ] Other (specify) _____

Section C: Understanding of Flood Warnings

1. Have you ever received flood warnings via the radio? [ ] Yes [ ] No
2. If yes, did you understand the warning? [ ] Yes [ ] No [ ] Partially
3. What language are the flood warnings typically broadcast in? [ ] Chichewa [ ] Sena [ ] English [ ] Other local language (specify)_____
4. What factors make it difficult to understand radio flood warnings? (Tick all that apply) [ ] Speed of the announcement [ ] Language used [ ] Lack of detailed instructions [ ] Background noise/poor audio quality [ ] Other (specify) _____
5. How do you react when you hear a flood warning? [ ] Seek more information from others [ ] Take immediate action [ ] Do nothing because I don't understand the warning [ ] Other (specify) _____
6. How quickly do you typically receive flood warnings, and does this timing allow you adequate time to respond? [ ] Very timely - sufficient for response [ ] Somewhat timely - barely enough time [ ] Not timely - insufficient for proper response [ ] Never receive warnings in time

Section D: Improving Radio-Based Flood Warnings

1. What improvements would you suggest to make flood warnings more accessible for visually impaired individuals? (Examples: changes in language, timing, repetition, sound signals, etc.)

_____

_____

_____

Additional Comments

Please share any other thoughts or suggestions regarding radio-based flood warnings:

2. QUESTIONNAIRE FOR LOCAL COMMUNITY MEMBERS

Introduction: Thank you for participating in this research study on the effectiveness of radio-based flood warnings for visually impaired individuals in T/A Ngabu. Your insights will help us understand community support systems and improve warning mechanisms. All information provided will be kept confidential, and your participation is completely voluntary. You may withdraw at any time without penalty.

Section A: General Information

1. Name (optional): _____
2. Age: [ ] 18-30 [ ] 31-45 [ ] 46-60 [ ] 60+
3. Gender: [ ] Male [ ] Female [ ] Other
4. Occupation: _____

Section B: Radio Accessibility and Reliability

1. Do you own a radio? [ ] Yes [ ] No
2. How often do you listen to radio flood warnings? [ ] Always [ ] Sometimes [ ] Rarely [ ] Never
3. How reliable are radio warnings in your area? [ ] Very reliable [ ] Somewhat reliable [ ] Not reliable
4. What challenges affect radio flood warning broadcasts in your area? (Tick all that apply) [ ] Power outages [ ] Weak radio signals [ ] Lack of local language broadcasts [ ] Inconsistent broadcasting schedules [ ] Other (specify) _____

Section C: Support for Visually Impaired Individuals

1. Do you know any visually impaired individuals in your community? [ ] Yes [ ] No

2. How do they receive flood warnings? [ ] From family members [ ] From neighbors [ ] Other (specify) _____
3. Besides family and neighbors, do community groups, leaders, or organizations help disseminate warnings to visually impaired individuals? [ ] Yes (please specify): _____ [ ] No [ ] Not sure
4. Are there any existing community-based solutions that assist visually impaired individuals during floods? [ ] Yes (please describe): _____ [ ] No [ ] Not sure
5. Do you think radio warnings are effective for visually impaired individuals? [ ] Yes [ ] No [ ] Not sure
6. What should be done to improve access to flood warnings for visually impaired individuals?

_____

_____

Additional Comments

Please share any other thoughts or observations regarding flood warnings for visually impaired individuals:

_____

_____

_____

3. QUESTIONNAIRE FOR RADIO STATION REPRESENTATIVES

Introduction: Thank you for participating in this research study on the effectiveness of radio-based flood warnings for visually impaired individuals in T/A Ngabu. Your professional insights are crucial for understanding current practices and identifying improvements. All information provided will be kept confidential, and your participation is completely voluntary. You may withdraw at any time without penalty.

Section A: General Information

1. Name of Radio Station: _____
2. Location of the Radio Station: _____
3. Your Role at the Radio Station: _____

Section B: Flood Warning Broadcasts

1. Does your radio station broadcast flood warnings? [ ] Yes [ ] No
2. If yes, how often are flood warnings aired? [ ] Daily [ ] Weekly [ ] During flood season only [ ] Other (specify) _____
3. In which languages do you broadcast flood warnings? _____
4. Do you follow any national or local guidelines for broadcasting flood warnings? [ ] Yes (please specify which guidelines): _____ [ ] No
5. Do you have specific guidelines for making broadcasts accessible to visually impaired listeners? [ ] Yes (please describe): _____ [ ] No
6. What format do you use for flood warnings? (Tick all that apply) [ ] Verbal announcements [ ] Interviews with disaster officials [ ] Emergency sound signals (specifically designed to be recognizable by visually impaired listeners) [ ] Other (specify) _____
7. Do you include content tailored for visually impaired individuals? [ ] Yes [ ] No
8. What measures do you take to ensure warning messages are clear and actionable?

   _____

   _____

9. What challenges do you face when broadcasting flood warnings? (Tick all that apply) [ ] Poor signal strength [ ] Limited airtime for warnings [ ] Lack of guidelines on how to communicate with visually impaired individuals [ ] Unreliable information sources [ ] Other (specify) _____
10. How does your station assess the effectiveness of broadcast flood warnings? [ ] Through listener feedback [ ] Formal surveys [ ] Hotline calls [ ] We don't currently assess effectiveness [ ] Other (specify): _____

Section C: Technical Aspects

How reliable is your broadcasting system during severe weather? [ ] Very reliable [ ] Somewhat reliable [ ] Unreliable [ ] Very unreliable

What backup systems do you have in place for power outages? _____

How do you ensure coverage reaches remote areas like in T/A Ngabu?

_____

Section D: Feedback and Improvement

Do you receive feedback from visually impaired listeners about flood warnings? [ ] Yes [ ] No

If yes, what is the most common feedback received? _____

What improvements would you suggest for making flood warnings more accessible to visually impaired listeners?

_____

_____

Additional Comments

Please share any other insights regarding radio-based flood warnings for visually impaired individuals:

_____

_____

_____

4. QUESTIONNAIRE FOR DISASTER RISK MANAGEMENT OFFICER

Introduction: Thank you for participating in this research study on the effectiveness of radio-based flood warnings for visually impaired individuals in T/A Ngabu. Your professional expertise is essential for understanding institutional approaches and identifying policy improvements. All information provided will be kept confidential, and your participation is completely voluntary. You may withdraw at any time without penalty.

Section A: Professional Background

How long have you been working as a Disaster Risk Management Officer in Chikwawa District? [ ] Less than 1 year [ ] 1-3 years [ ] 4-6 years [ ] More than 6 years

What is your primary role in flood warning dissemination? _____

Section B: Flood Early Warning Systems

What flood warning systems are currently in place in T/A Ngabu? [ ] SMS alerts [ ] Community messengers [ ] Sirens [ ] Radio broadcasts [ ] Other (please specify): _____

How do you ensure flood warnings reach visually impaired individuals in T/A Ngabu? _____

Do you partner with disability-focused organizations to ensure more inclusive warning dissemination? [ ] Yes (please describe these partnerships): _____ [ ] No

What specific protocols exist for warning vulnerable groups, including visually impaired? _____

Section C: Radio-Based Warning System

How effective do you consider radio-based flood warnings for visually impaired individuals? [ ] Very effective [ ] Somewhat effective [ ] Not very effective [ ] Not effective at all

Please explain your answer: _____

What challenges have you observed in delivering flood warnings to visually impaired individuals through radio? _____

How are warning messages adapted for those with multiple vulnerabilities (e.g., elderly and visually impaired individuals)? _____

How do you coordinate with local radio stations during flood emergencies? _____

What quality control measures are in place to ensure warning messages are clear and actionable? _____

Section D: Community Response and Feedback

How do you monitor the effectiveness of flood warnings among visually impaired individuals? _____

What feedback mechanisms exist for visually impaired individuals to report issues with flood warnings? [ ] Direct report to DRM office [ ] Through disability organization [ ] Other (please specify): _____

Based on past flood events, how would you rate the response of visually impaired individuals to radio warnings? [ ] Very good [ ] Good [ ] Fair [ ] Poor

Please explain your rating: _____

Section E: Improvement and Recommendations

What are the main gaps in the current radio-based warnings system for visually impaired individuals? _____

What improvement would you recommend for: a. Message content: _____ b. Delivery method: _____ c. Timing of warnings: _____ d. Community engagement: _____

Additional Comments

Please share any other insights or recommendations not covered above:

_____

_____

_____

5. FOCUS GROUP DISCUSSION GUIDE

Introduction: Thank you for participating in this focus group discussion on radio-based flood warnings for visually impaired individuals in T/A Ngabu. The purpose of this discussion is to gather diverse perspectives on current practices and potential improvements. Your contributions are valuable, and all information shared will be kept confidential. Participation is voluntary, and you may withdraw at any time.

Discussion Topics:

How do visually impaired individuals currently receive flood warnings?

Probing questions:

What are the most common sources of warning information?

How do these sources vary during different times of day or seasons?

What are the biggest challenges visually impaired individuals face in accessing and understanding radio warnings?

Probing questions:

Are there specific technical issues with radio broadcasts?

How do language barriers affect comprehension?

How effective are current radio broadcasts in conveying flood warnings?

Probing questions:

What elements make a warning easily understandable?

What makes warnings difficult to interpret or act upon?

How do cultural practices and community norms influence the understanding and response to flood warnings?

Probing questions:

Are there traditional communication methods that could be incorporated?

How do local beliefs affect response to warnings?

What improvements can be made in how flood warnings are communicated via radio?

Probing questions:

What specific formats would be most helpful?

How could the timing or frequency of broadcasts be improved?

What role can the community play in ensuring visually impaired individuals receive timely flood warnings?

Probing questions:

How could community support systems be strengthened?

What community-led initiatives could complement radio warnings?

Is there anything else you would like to share about flood warnings for visually impaired individuals that we haven't covered in our discussion?

Closing

Thank you for your participation and valuable insights. Your contributions will help improve flood warning systems for visually impaired individuals in your community.