ASSESSING DROUGHT VULNERABILITY AMONG FARMING COMMUNITIES IN KARONGA DISTRICT: CASE STUDY OF TA KYUNGU.

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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.

MALAWI UNIVERSITY OF SCIENCE AND TECHNOLOGY

NDATA SCHOOL OF CLIMATE AND EARTH SCIENCES

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14th JUNE, 2024

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Abstract

A number of sectors in Malawi are seriously threatened by drought vulnerability, with agriculture being the most affected, followed by water, gender, hearth and fisheries. This study investigate the vulnerability to drought in traditional authority Kyungu, Karonga District, Malawi, focusing on the impact on agriculture, livelihoods and food security. Given the region's reliance on rain-fed agriculture and recurrent droughts, understanding and assessing vulnerability is crucial for effective disaster risk reduction. The research employs both qualitative and quantitative methods within descriptive design. Data collection involved structured questionnaires and semi-structured interviews with Community Development Committee (VDC) members and local experts, supplemented by secondary data from the government and survey reports. The Community-Based Risk Index (CBDRI) was used to quantify vulnerability, integrating factors of hazard's exposure, susceptibility and capacity. The study reveals that 60% of the communities exhibit medium vulnerability to drought, 29% high vulnerability and 10.7 % low vulnerability. Key factors contributing to high susceptibility include poverty, limited access to essential services, high dependency ratio and small employment base. Exposure levels are generally low except in areas with significant agricultural activity. A lack of capacity to mitigate and adapt to drought is widespread, with insufficient infrastructure and funding for disaster risk management. The findings highlights the urgent needs for targeted interventions to reduce drought vulnerability in TA Kyungu. Identifying areas of high vulnerability allows more efficient resource allocation and development of tailored strategies to enhance community resilience. This study contributes essential data for policymakers and supports the formulation of policies aimed at sustainable development and disaster risk reduction in vulnerable communities.

Acknowledgements

I would like to express my sincere gratitude to my wonderful research supervisor, Mrs. Nthara, for her constant direction, tolerance, and assistance during project. Your knowledge and support have been very helpful in determining the course and approach of study.

I deeply indebted to Mr. Victor Phiri, the diligent disaster risk management officer at the district level. Your invaluable insight, feedback and dedicated to community resilience have greatly enriched this research endeavor.

To Mr. Kanyimbo and Mr. Mthari of Environmental Protection Agency (EPA), I would like to sincerely thank you. In the context of the project, your knowledge and direction have in identifying all VDCs within TA Kyungu.

Additionally, I would like to express my gratitude to each and every member of the traditional authority Kyungu village development committees. Your cooperation, local expertise and dedication to the welfare of the community have been essential to this research's success.

Without the kind of assistance from all above people, my effort would not have feasible. I am sincerely appreciative for their effort and the opportunity to learn from their expertise. May God bless you all.

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ABBREVIATION/ ACCRONYMES

%	percentage
ADC	Area Development Committee
C	Capacity
CBDRI	Community-Based Disaster Risk Index
CBO	Community-Based Organization
DoDMA	Department of Disaster Management Affairs
DRR	Disaster Risk Reduction
E	Exposure
EPA	Environment
GIS	Geographical Information Science
GVH	Group Village Head
S	Susceptibility
s	score
SDG	Sustainable Development Goals
TA	Traditional Authority
VDC	Village Development Committee
w	weight

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1. INTRODUCTION

1.1. Background

Vulnerability is the propensity or predisposition to be adversely affected. It encompasses a variety of concept and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt (Birkmannet. Al. 2014). Vulnerability takes a myriad of frameworks and definitions, however, the exposure, susceptibility, and capacity and resilience framework has been widely adopted by the communities studying the hazards associated with both climate change and disaster e.g. (Mwale et al., 2015)

Susceptibility is the propensity of elements at risk to suffer harm while exposure is the presence of people livelihoods, environmental services and resources, infrastructure or economic social and cultural assets in place that could adversely affected and resilience is ability of system and its component parts of a system and its component parts to anticipate ,absorb accommodate, or recover from the effects of hazardous events, which is sometimes used interchangeably with capacity across vulnerability literature (Mwale et al., 2015).

Interaction of vulnerability with hazard, such as drought, is likely to make disaster out of the hazard (Birkmann, 2006). In order to establish effective disaster risk reduction, vulnerability assessment is therefore a necessary first step (Munyani et al., 2019; Nasiri, 2016). Every nation uses the Disaster Risk Reduction (DRR) concept to lessen problems associated with disasters.

Measuring vulnerability is an alternative to adopt while a disaster stakeholders use distinct measures to decrease catastrophe risk (Munyani et al. 2019). In order to create a disaster resilient society, assessing degrees of vulnerability help to identify novel DRR solutions (Munyani et al., 2019).

In this study drought is defined as unusual shortage of water that produce an adverse effects on society and economy (Maybank et al., 1995).

Malawi, just like most countries in Africa has been experiencing drought in past years (Hamel, 2016). Increased frequency of drought-occurrences has been observed from 1980s due to climate change (Malawi Government, 2006). Drought lead low yield which later lead to food insecurity. About 90% of the population in Malawi rely on rain fed agriculture. Due to this overreliance, people's livelihoods and economy are vulnerable to hydrological hazards such as droughts, which account for 70% of all the hazards in the region (Kamanga, et al., 2021).

Drought have had varied socio-economic impact. For instance, the 2004/05 drought plunged the country into one of the most food security crises. As a result of the crises, 30% of the population needed emergency food assistance and a total of 5,100,000 people mostly farmers, women and children were affected as a result of crop failure, insufficient water-supply and malnutrition (Chabvungma et al., n.d.).

One of the goals of Sustainable Development Goals (SDG) is to end poverty in Malawi, saying by 2030, they should build the resilience of the poor and those in vulnerable situation and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.

Karonga is one of the district in the northern part of Malawi and is located to western part of Lake Malawi. It has five TAs namely Mwakawoko, Kilupula, Wasambo, Kyungu and Mwilang'ombe. TA Kyungu is frequently hit by different natural and man induced disasters like earthquake, floods, pest and diseases and droughts to mention a few. The occurrence of drought has significant implications for communities, particularly for agricultural-dependent areas like in Traditional authority Kyungu in karonga district.

This research aims at assessing vulnerability to drought within Traditional Authority Kyungu in karonga district. Focusing on their effects on agriculture, livelihoods and food security. Drought have led to crops failure, reduced access to clean water, food insecurity and socioeconomic hardship among the local population.

This research have focused on different indicators of vulnerability such as exposure, susceptibility and capacity.

Exposure have focused on structure that exist within TA Kyungu like percentage (%) of land under rain fed agriculture and livestock production in the commune and economy by focusing on income per day.

Susceptibility have been looked in terms of physical, social, economic and environment. For instance in physical perspective, it have been looked in terms of percentage of people who have access to services like portable water. Social as one of indicator of susceptibility have been looked in terms of poverty level, literacy level, attitude, community participation, dependency ratio, average time to hearth facility, percentage of households with family member with chronic illness, percentage of household dependency on family farm for food, average of month household struggle to find food and percentage of people who do not save crops. Economic have been focused on local resource base, diversification and stability.

Capacity have been looked in terms of social capacity, economic capacity and management and institutional capacity. Social capacity have been focused on public awareness programs, school curriculum, public participation, local risk average crop diversification index range >0-1, average agriculture diversification index. Economic capacity have been focused on local emergency fund, access to national fund, access to international funds, insurance market, mitigation loans and public works. Management and institutional capacity which have been focused on risk management or emergency, availability of early warning system, institutional capacity building and communication.

1.1. Problem statement

In Malawi, different sectors are vulnerable to drought. The most vulnerable sector is agriculture followed by water, gender, health and fisheries (Chabvungma et al., n.d.). Traditional Authority Kyungu faces recurrent challenges related to drought, which pose significance threats to well-being and resilience of its communities. Despite being a pressing issue, there is lack of comprehensive assessment and understanding of

drought vulnerability within this specific region. This knowledge gap hinders the development and implementation of effective and mitigation and adaptation strategies to address the socioeconomic and environmental impact of drought in TA Kyungu. Thus, there is an urgent need for a comprehensive study to assess drought vulnerability among communities in TA Kyungu, providing essential insight and data for informed decision-making and sustainable development in this vulnerable area.

1.2. Main objective

Assessing drought hazard vulnerability in traditional authority Kyungu in Karonga by focusing on exposure, susceptibility and capacity.

1.3. Specific objectives

a) Quantifying vulnerability to drought in Traditional Authority Kyungu in Karonga district.

b) To identify key factors contributing to different levels of vulnerability among communities.

c) To classify different level of vulnerability to drought in TA Kyungu.

d) To evaluate the effectiveness of existing adaptation and mitigation measure to reduce vulnerability.

1.4. Research questions

This case study therefore seek to answer the following questions;

a) What are key contributing factors that makes traditional authority Kyungu vulnerable to drought?

b) Where are the areas of high vulnerability to drought within traditional Kyungu?

c) What are the extent of vulnerability to drought within TA Kyungu?

d) How can Community-Based Disaster Risk Index (CBDRI) can be used to quantify the vulnerability?

1.5. Significance of study

Although several studies have been conducted on drought in general, they did not focus on quantifying vulnerability to drought in the Traditional Authority Kyungu. The study will help in identifying relative vulnerabilities of specific people and places. This will help decision-makers at local, regional, national level to have crucial data about the level of vulnerability at different areas within TA Kyungu. This Community-Based Disaster Index provides a holistic understanding of drought vulnerability. It help in prioritize intervention, allocate resources efficiently and develop target strategies for building resilience and reducing the impact of droughts on vulnerable community.

Classifying vulnerability will help in identifying areas with high vulnerability and potential hotspots. This information is essential for targeting risk reduction efforts and potentially saving lives and properties during drought events.

The research findings will influence policy development at various levels, leading to creation of policies and guidelines that prioritize disaster risk reduction and enhance resilience-building in vulnerable community.

Evaluating and existing adaptation and mitigation measures ensures that resources are not wasted on ineffective strategies. It will allow for adjustments and improving in the approach to drought vulnerability reduction.

This research study will add the body of academic knowledge and practical solution in addressing drought vulnerability.

2. LITERATURE REVIEW

2.1. Drought

Drought is recurrent and debilitating natural hazard that threatens the livelihoods and wellbeing of communities worldwide. Drought is one of the most damaging environmental phenomena, doing enormous damage to humankind. Thus, it is no mere chance that the international scientific community pays much attention to the study of drought. Minimizing only the disastrous impact of droughts will provide, as the founder of astronautics K.E. Tsiolkovskiy said, "A heap of grain and an ocean of power." Despite a great number of works dealing with droughts, their nature is not finally clear. The methods for predicting droughts are also far from perfect. As climate change exacerbates the frequency and severity of drought events, understanding and quantifying vulnerability to drought risk becomes paramount for effective disaster risk reduction and adaptation strategies. The concepts of vulnerability to drought has evolved over time to encompass a multidimensional perspective that goes beyond physical exposure to encompass socioeconomic, environmental and institutional factors (Adger, 2006). Vulnerability is understood as propensity of a system or community to experience harm from drought events (IPCC, 2014). In this framework, vulnerability is a function of exposure, sensitivity and adaptive capacity (Turner et al., 2003).

Drought poses significant challenges to agricultural community's worldwide, particularly in the regions where agriculture is primary livelihood. Karonga district in Malawi is no exception, with its farming communities facing recurring drought events that threatens their livelihoods and food security. This literature review aims to assess drought vulnerability among farming communities in Karonga district, focusing on TA Kyungu

2.2. Community-Based Disaster Risk Index

Community-Disaster Risk Index is a tool used to assess and quantify the vulnerability of a community to various types of disaster, such as natural hazard and man-made.

The CBDRI, rooted in this Disaster Risk Reduction (DRR) framework, has gained prominence for its community-centered approach. CBDRI integrate quantitative and qualitative data to capture vulnerability dimensions specific to a community (UNDRR, 2019). It allows for a participatory assessment that engages local stakeholders, enhancing the relevance and ownership of the results (Birkmann, 2009).

Several case studies highlight the effectiveness of CBDRI in assessing drought vulnerability. In their study in rural community in Nepal, Gautam and Timilsina (2016) utilized CBDRI to identify critical drought vulnerability, including water scarcity, crop failure and income loss. Similarly, in Ethiopia, Degefu et al, (2018) employed CBDRI to assess vulnerability and prioritize interventions for pastoralist communities facing recurrent drought.

While CBDRI has shown promise in various contexts. Its adaptation to Traditional authority Kyungu in Karonga, Malawi, is an area of exploration. Karonga is characterized by a unique socio-economic and environmental landscape, which necessitates tailored approaches to vulnerability assessment. Physical, social, economic and environmental indicators will be very crucial in this research.

2.3. Vulnerability

Vulnerability to drought refers to degree to which region is susceptible to the adverse effects of extended periods of water scarcity (Smith, 2018). This vulnerability is influenced by a range of interconnected factors into three main dimensions and these are; environmental factors which include natural conditions that affects a region`s ability to cope with drought such as climate patterns, soil quality and topography (Jones & brown, 2019), socioeconomic factors which highlight that vulnerability is shaped by human-related factors such as income level, access to resources and presence of social safety nets (Johnson et al., 2020) and institution and governance factors which shows that the effectiveness of policies, regulations and mitigating drought impact is critical aspects of vulnerability (Adams & White, 2017).

Numerous studies that have assessed Malawi susceptibility to drought have yield important insight into the elements that particularly increase vulnerability in the karonga district. Socioeconomic the social variables like poverty, resource scarcity and reliance on rain-fed agriculture make karonga district more vulnerable to drought (Banda et al. 2019). The environmental factors, including rainfall variability and land degradation, also contributed to drought vulnerability in the region (Chavula et al., 2017).

The community-level studies have explored the impact of drought on local population and their coping strategies. Manda et al, (2020) conducted a household survey in Karonga district, revealing that drought-induced food insecurity disproportionately affects vulnerable groups, including women and children.

Table 1. Indicators for drought vulnerability as per IPP framework

Factor Component	Indicator name	Indicator
EXPOSURE		
Structures	(E1) Rain fed Agriculture dependency	% of land under rain fed Agriculture
	E2)Livestock production	% Livestock production in the commune
Economy	(E3) Economy	% Average income per day
SUSCEPTIBILITY		
	(S1) aridity Index	% of value class
Physical	(S2) Access to services	% homes with portable water
	(S3) Density	How many people per km^2 live in
	(S4) Demographic pressure	% of people below poverty level
Social	(S5) Poverty level	% population below poverty level (1USD/day)
	(S6) Literacy	% of people that can read and write
	(S7) Attitude	Priority a of population gives to protect a threat against drought
	(S8) Community Participation	% of voter turnout at last commune elections

	(S9) Dependency ratio	Ratio of the population under 15 and over 65 years of age to the Population between 19 and 64 years of age.
	(S10) Average time to health facility (min)	Average time to a health facility
	(S11) Percent of households with family member with chronic illness	% of households with chronically ill family members.
	(S12) Percent of households dependent on family farm for food	% source of household food.
	(S13) Average number of months households struggle to find food (range: 0–12)	Average number of month's household struggle to find food.
	(S14) Percent of households that do not save crops	Percent of households that do not save crops.
Economic	(S15) Local resource base	Total available budget Percentage of households in commune dependent solely on agriculture as a source of income
	(S16) Diversification	
	(S17) Stability	% Business with fewer than 20 employees.
Environmental	(S18) Environmental	Area under forest

CAPACITY AND

Factor Component	Indicator name	Indicator
MEASURES		
		Availability of alternative Agricultural technologies.
	(C1) Preventive measures	% of people with access to water supply infrastructure such as reservoirs, pipelines, and
Physical capacity	(C2) Water supply infrastructure	treatment plant

Factor Component	Indicator name	Indicator
	(C3) Environmental management	Measures that promote and enforce nature water conservation.
Societal capacity	(C4)Public awareness programs	Frequency of public awareness programs
	(C5) School curriculum	Scope of relevant topics taught at school
	(C6)Public participation	Emergency committee with representatives
	(C7) Local risk	Grade of organization of local groups
	(C8)Average Crop Diversification Index range >0-1	number of crops grown by communes

Economic capacity	(C9)Average Agricultural Diversification Index (Range : 0.20 – 1)	Number of agricultural activities taking place in the commune.(e.g Crop farming, fishing, or animal rearing).
	(C10) Local emergency fund	Local emergency response fund as % of local budget.
	(C11) Access to national fund	Release period of national emergency funds.
	(C12) Access to International funds	Access to international emergency funds
	(C13) Insurance market	Availability of loans for disaster risk reduction measures

Factor Component	Indicator name	Indicator
	(C14) Mitigation loans	Availability of loans for disaster risk measures
	(C15) Reconstruction loans	Availability of reconstruction credit for affected household
	(C16) Public works	Magnitude of local public works programs
Management and		

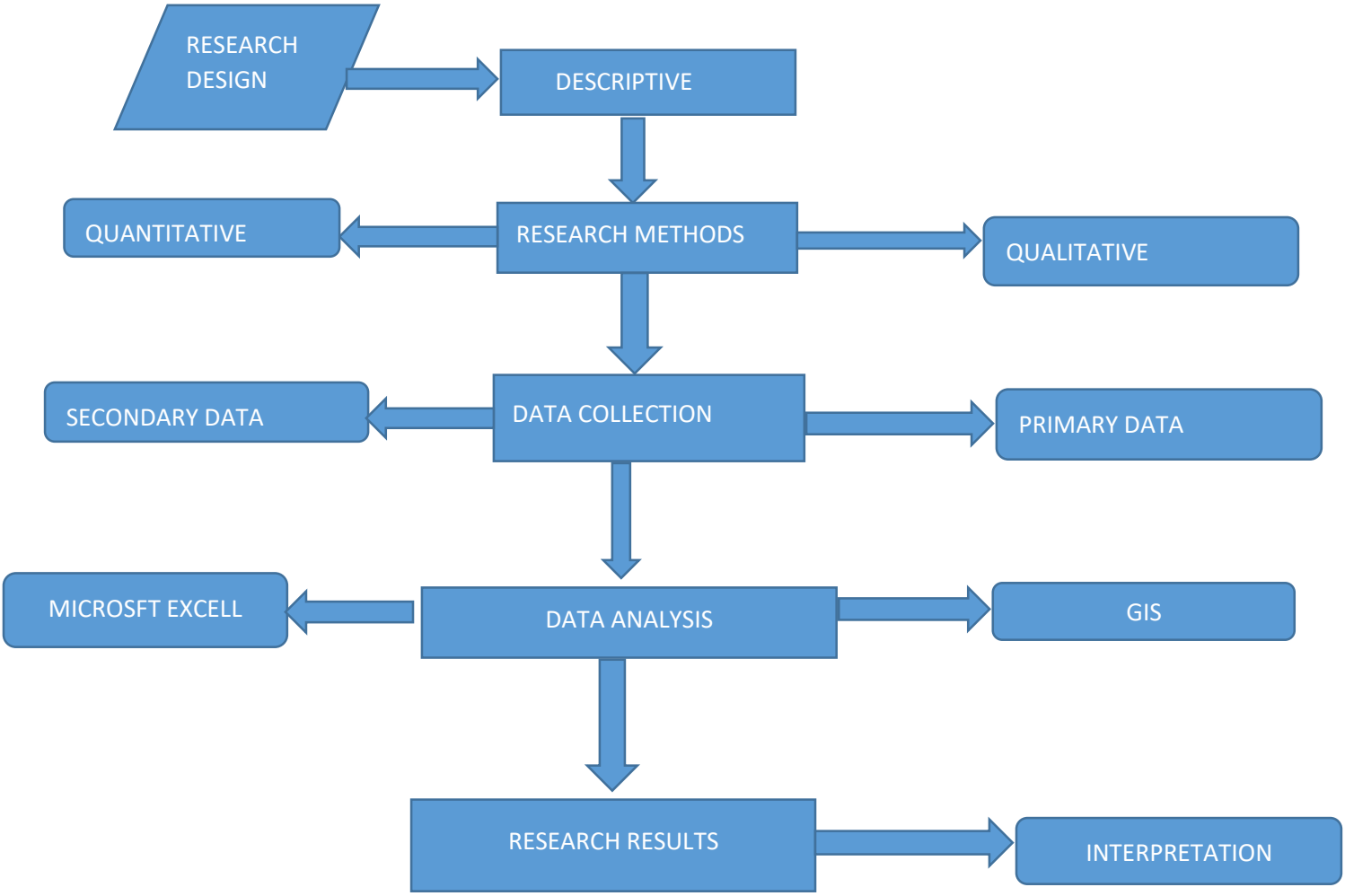
Institutional Capacity	(C17) Risk management / emergency	Meeting frequency of a community committee
	(C18) Risk map	Availability of circulation mas
	(C19) Early warning system	Effectiveness of early warning systems
	(C20) Institutional capacity building	Frequency of training of local institutions
	(C21) Communication	Frequency of contact with district level institutions.

3. METHODOLOGY

3.1. Study design

Both qualitative and qualitative research method have been used in this descriptive study design. While using Microsoft excel, the quantitative methods have been used to quantify and analyze the data in order to better understand the behavior and attitude of the chosen sample size in the study area.

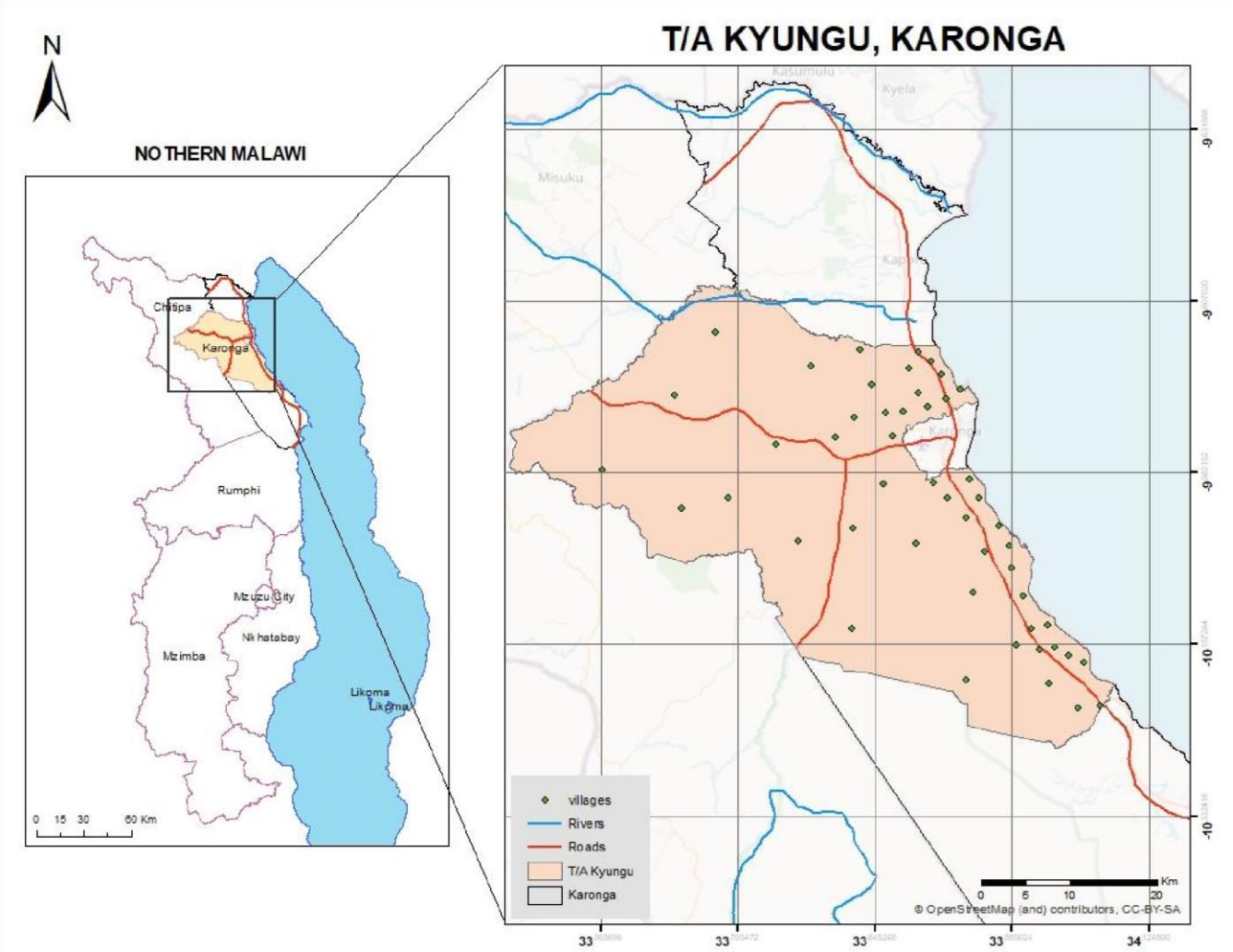
Figure 1. Flow diagram



3.2. Study area

The study have been conducted in TA Kyungu in Karonga district (Northern Malawi). The TA cover an area of 1,614km^{2}and has a population of 89,672 with population density of 55.55/km^2 (population census, 2018).

Figure 2. Map of TA Kyungu



3.3. Site selection

The area has been chosen as the case study of the research because is one of the areas in the district that experience high temperature, making it prone to drought and almost each and every year the area is vulnerable to drought hazard. Purposive sampling technique will be used to get information from expert like Village development committee (VDC) and there are 50 VDCs in TA Kyungu in Karonga (Gondwe, 2018).

3.4. Data collection

The primary data for chosen sample size have been collected through interviews (for qualitative data) and structured questionnaire (for quantitative data) administered to a group of experts and knowledgeable people representing the community (Bollin et al., 2003). The knowledgeable people are mainly from Village Development Committee (VDC). VDC members are people with various qualifications mainly from Community Based Organizations (CBOs) and Government departments. In this study, the questionnaire have made up of both close and open questions on the objectives of this research. The questions was translated into a local language (Tumbuka) for easy understanding by the responders. Semi structured interviews will also be conducted with the responders and the Group Village Heads (GVHs) of the area to determine the quantitative level of their vulnerabilities.

The 2018 population and housing census data, as well as the fifth Integrated Household Surveys, provided secondary data including the dependency ratio. The Ministry of Agriculture, Irrigation and Water Development provided the data used to produce the Agriculture and Crops Diversification Index. The Geographic Information System (GIS) was used to determine a community's percentage of forested area.

3.1.1. Identifying and analyzing conditioning factors

Survey and interviews have been conducted with VDC and experts to gather qualitative data on conditioning factors contributing to vulnerability. Conditioning factors have been analyzed based on the weight it has on vulnerability.

3.1.2. Quantifying vulnerability to drought

Selection index

The vulnerability to drought have been quantified using Community-Based Disaster Risk Index (CBDRI). So CBDRI is a measurement or assessment tool used to evaluate the level of disaster risk within a specified community. It take onto account various factors related to the community`s vulnerability to disasters and its capacity to cope with and recover from them.

$$CBDRI = \nu (H + E + S - C)$$

Equation 1. To calculate Community- Based Disaster Risk Index

$$H = \sum_{i=1}^{h} WiXi,\ E = \sum_{j=1}^{q} WjXj,\ S = \sum^{r}{}_{k=1} WkXk,\ C = \sum_{y=1}^{z} WyK\,y$$

Equation 2 . To calculate hazard, exposure, susceptibility, and capacity

Where, H, E, S and C are the hazard, exposure, susceptibility and capacities (resilience) subcomponents with a range from 0 to 100; $\nu = 0.33$ as a constant. This factor keeps the final value of risk within 0 and 100. W is a weight reflecting indicator importance in the subcomponent. h, q, r, and z are the total number of indicators in the hazard, exposure, susceptibility and capacity components respectively. x is a score allocated to the indicator in the sub-component and is equal to either 1 (low), 2 (medium) or 3 (high).

The CBDRI employs a weighting scheme to account for the varying significance of variables with respect to risk. Thus in addition to assigning a score of 1, 2, or 3, the community also assign weight to each of the factors within the sub-component. The study employed a weighting ranging from 1 to 10, where 10 was the considered highly significant. For instance, a score (x) of 1 denotes low capacity with regard to this variables when irrigation schemes are absent. Even though the community may not

agree, irrigation scheme are significant indicator that can help increase overall drought prediction ability.in this instance, they would assign a weight (w) of 9 to the indicator irrigation scheme. Comparably adding catastrophic studies to the curriculum for every grade results in a score of 1, which denote a minimal impact of susceptibility. Nonetheless, the community may assign a 4 to the indication, indicating that it is not a factor that significantly affect their ability as a society.

Since CBDRI, measure risk directly but per equation (1), it is possible to disaggregate it to vulnerability directly as in equation (3). Thus.

$V = 1/3\ [E+S+ (1-C)]$

Where, $1 - C$ = lack of capacity

Equation 3. To calculate vulnerability

3.1.3. Classifying different level of vulnerability

Geographical Information Systems (GIS) have been used to create vulnerability profiles of the study area.

3.1.4. Evaluating the effectiveness of existing adaptation and mitigation measures

Feedback have been collected from ADC and expert at district level about the effectiveness of current measures. Historical data will be analyzed to assess the impact of adaptation and mitigation measures on reducing vulnerability. Cost-benefit analysis have been conducted to determine the efficiency of these measures.

3.5. Data analysis

A descriptive analysis that describes household based on their demographics, household income, assets and social and economic vulnerability to drought have

been carried out. The data of the study have been manually reviewed for omissions, irrelevant and inaccuracies. After that, interview have been used to gather qualitative data and notes and data have documented at each session. Because some information will be gathered in Tumbuka, The recorded notes have translated into English. It has been divided into themes and subthemes and categorized. A questionnaire have used to gather quantitative data, and Microsoft Excel have been used to analyze data.

3.6. Data presentation

The data have been presented or shown in graphs, tables, and maps after being analyzed by Microsoft Excel.

3.7. Dissemination of the results

The results of the study will be sent inform of a report to the Department of Disaster Management Affairs (DoDMA) where other researchers, development partners and Non-Governmental Organizations can be able to access for use. The results can be used in the implementation of interventions and prioritize allocation of the scarce resources that will help to reduce the impacts of droughts in the most vulnerable parts of TA Kyungu in Karonga district. Researchers will also use the results as reference in their studies.

4. RESULTS AND DISCUTIONS

The results shows that majority of communities depicts medium level of vulnerability range (Figure 3). For instance, 29 percent of communities shows high vulnerability, 60 percent shows medium level of vulnerability and 10.7 percent shows low level of vulnerability. For instance Mwenenguwe A 0.6, Mwenichilanga B 0.59, Mweniyumba A 0.59, and Mweniyumba B 0.59 depict highest level of vulnerability. Zindi B 0.4, and Mbemba A 0.45 also depict the lowest level of vulnerability.

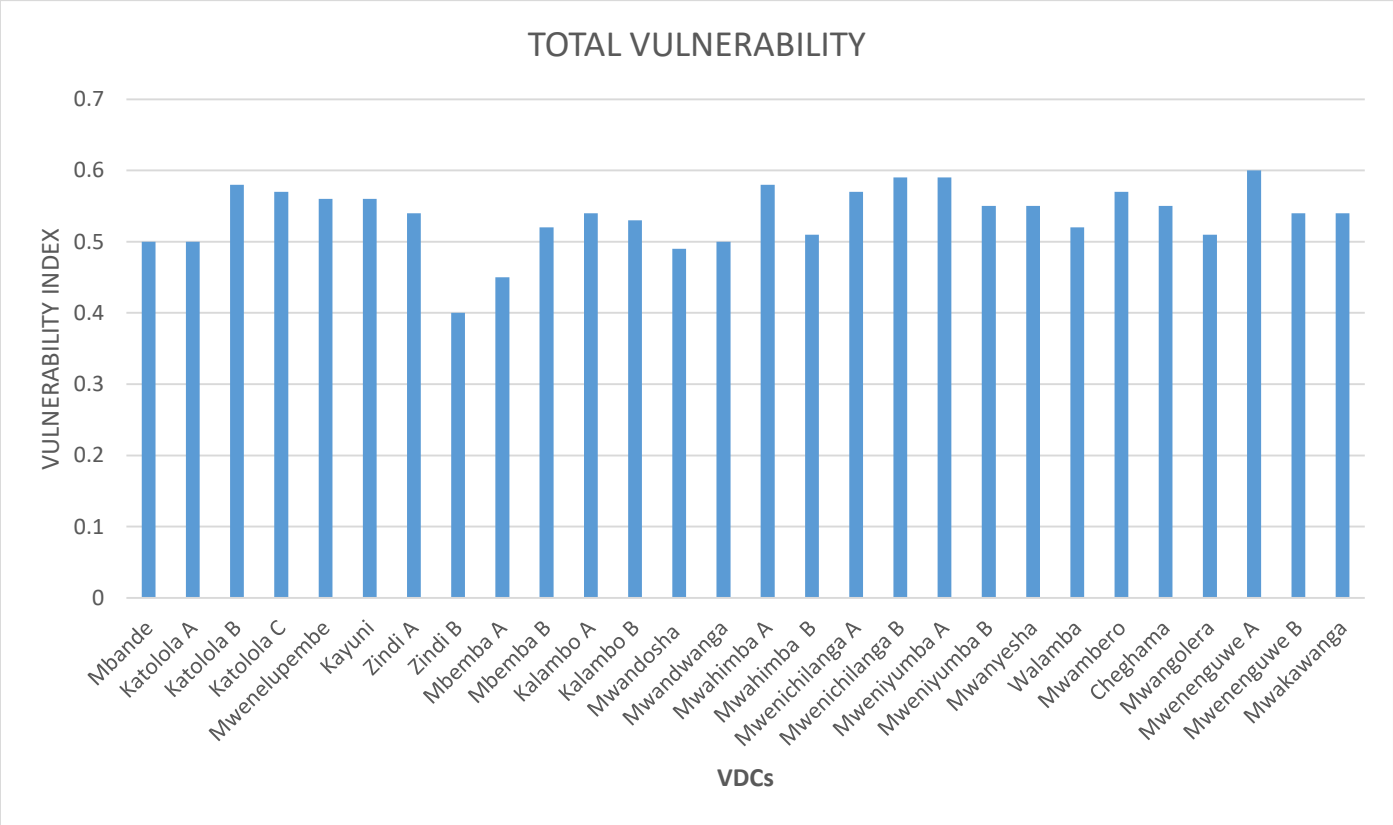


Figure 3. Total vulnerability

4.1. Susceptibility

Communes are often particularly susceptible. Thus, account for the majority of VDC's vulnerability (figure 5). The range of susceptibility magnitude is 0.59-0.8. The number

of factors that increase susceptibility is higher than the number of factors that reduces susceptibility, according to scores (appendix 1). This trend is frequently observed. High rate of poverty, restricted access to essential services, increased dependency ratios, reliance on family food, small base of employment, and general lack of resources to foresee and handle hazards are some of the driving factors. The only thing that seem to be contributing less to community well-being is literacy rate.

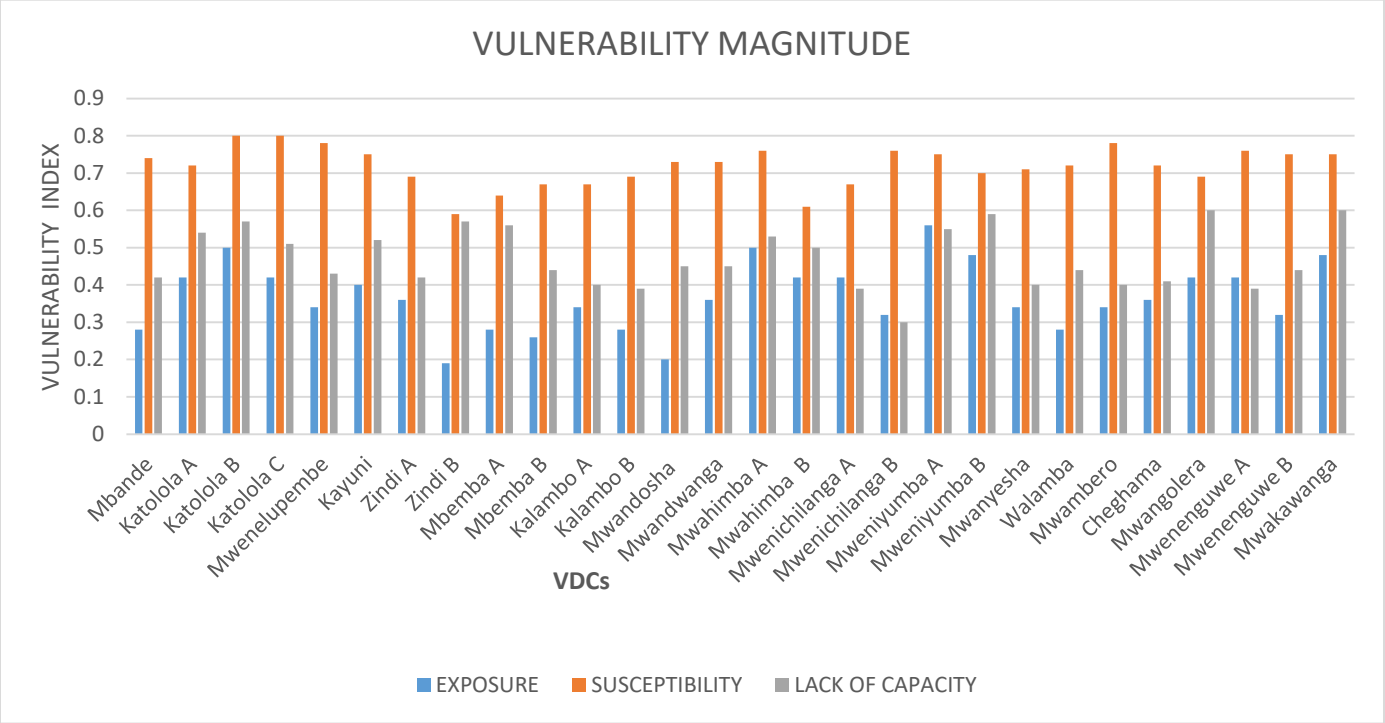


Figure 4 . Vulnerability magnitudes

4.2. Exposure

The research shows that exposure of Mweniyumba A, Mwahimba A, Katolola B are at least above 0.5 which shows highest level of vulnerability and it represent 10%, Zindi 0.19, Mwandosha 0.2, Walamba 0.28 and Mbande 0.28 and it represent 14% of communities depicting the least level of exposure and the other 76% communities depict the medium level of vulnerability.

The economy and livestock at risk receives extremely low exposure scores. However, as would be expected in rural economies most settlement have medium to high exposure to land used for rain-fed agriculture. A generally low level of exposure is the outcome. (See appendix 1).

The TA Kyungu, low exposure level may be caused by predominately rural demographics. The commune most at risk from drought vulnerability are Mweniyumba A, Katolola B, Mwahimba A, and Mweniyumba B. this make sense given that the commune are in town mostly with objects in danger.

4.3. Lack of capacity

TA Kyungu communities have medium capacity shortage. Magnitude vary from 0.39-0.6. Mwangolera community is having the highest lack of capacity level of all communities. The infrastructure needed to mitigate drought is inadequate in communes. They also lack alternative technology for capturing water. One notable issue is the scarcity of funding for catastrophe mitigation (Appendix1).

This incapacity is evident at all levels; municipal, district, and national. It applies to each stages of disaster risk management process. Reconstruction and insurance are not provided, nor is there any money for emergency situations. On the other hand, financing through public works comes out highly.

The public works program serves as safety net for low-income Malawian households and communities. Through labor-intensive activities like building, repairing and maintaining economic infrastructures like rural roads and small irrigation systems, as well as well as bettering natural resource management through afforestation and water harvesting in targeted VDC's and extension planning areas, it seeks to create employment opportunities for income transfer and building economic infrastructures (Subbarao et al., 2013)

4.4. Classifying different level of vulnerability

Geographic Information System have been used to come up with maps that shows different level of vulnerability in terms of exposure, capacity, susceptibility and total capacity.

According to the data of TA Kyungu, it has shown that there is different level of exposure, capacity and susceptibility. That makes TA Kyungu to have different levels of total vulnerability.

Figure 6 indicate that there is high level of vulnerability in Mwenenguwe A, Mwambero, Katolola B and C, Mwahimba A, and Mwenechilanga A where immediate attention is needed.

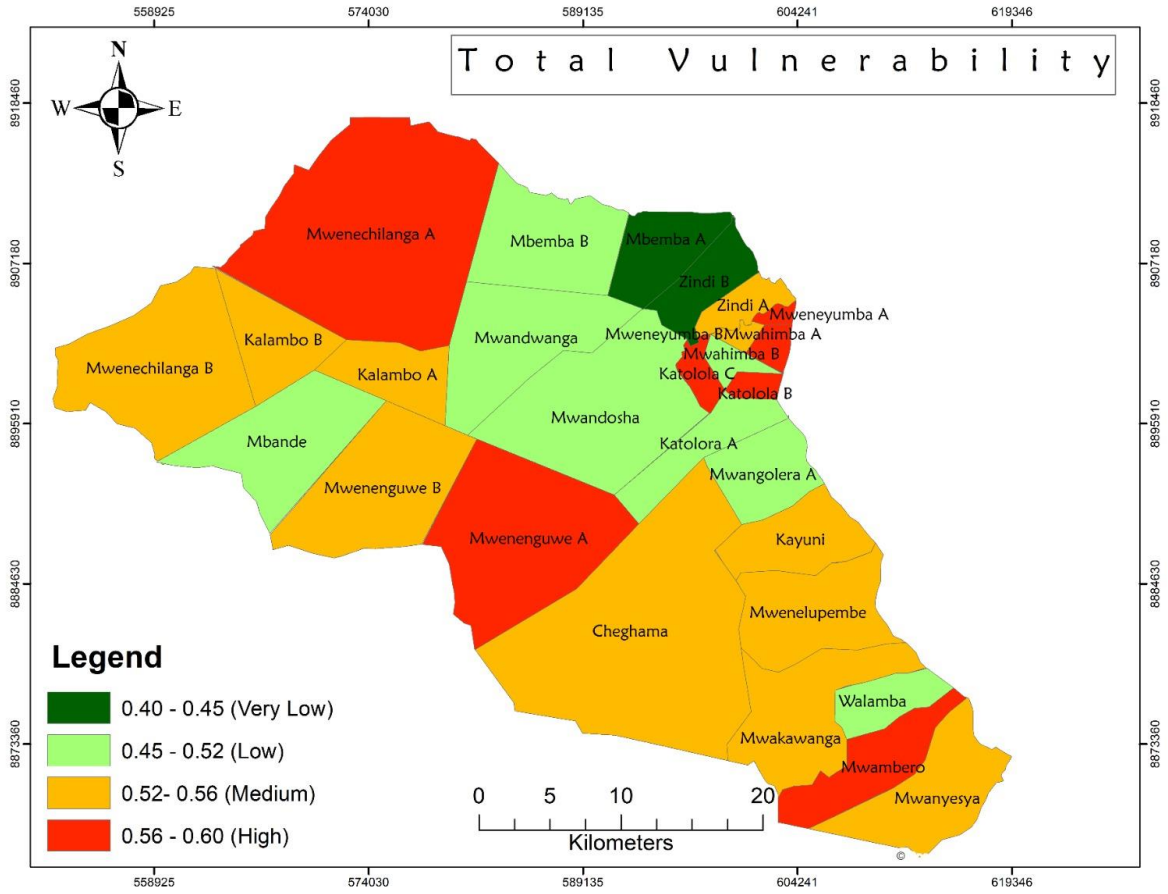


Figure 5. Showing total vulnerability

Figure 7 indicate that there is high exposure in most of VDC that are found within Karonga town and even in Mwakawanga VDC.

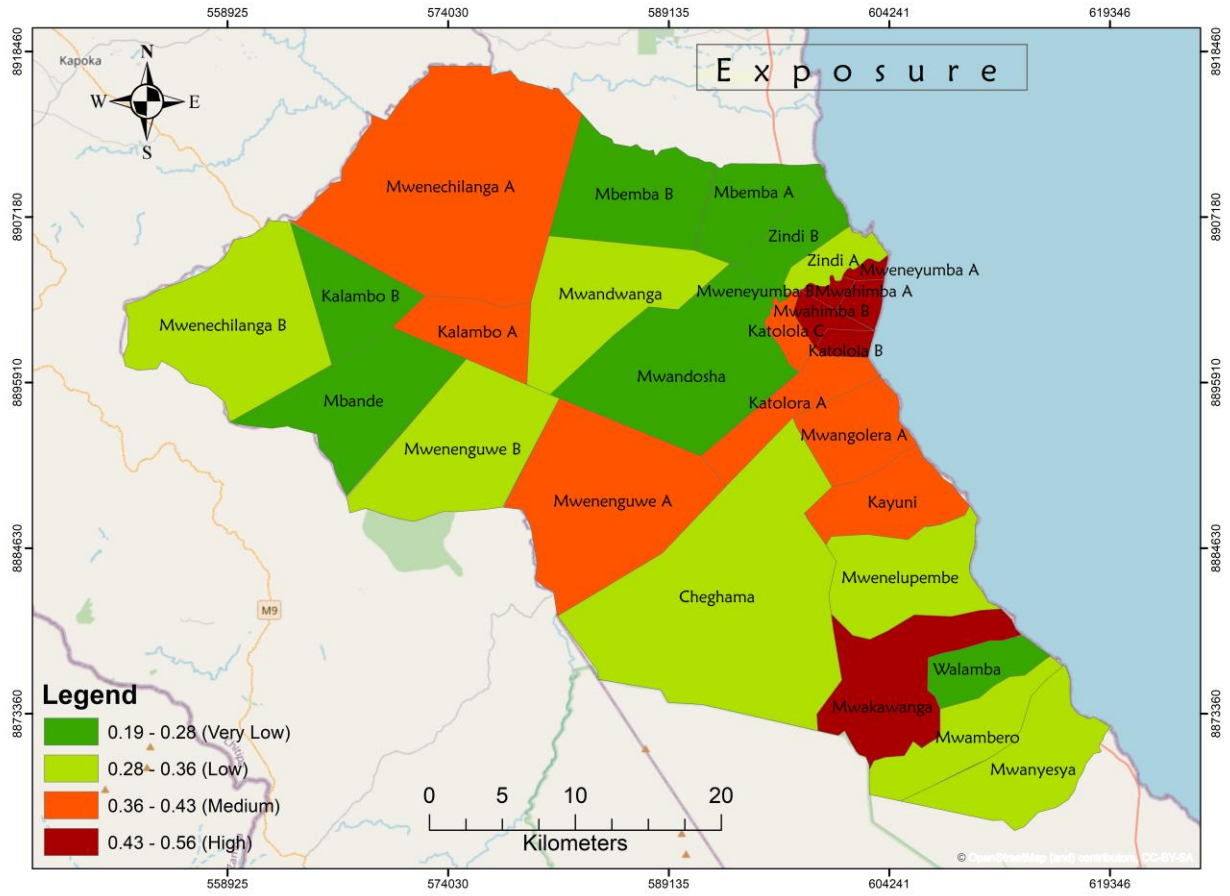


Figure 6 Showing exposure.

Figure 8 indicate that there is high lack of capacity in Mbemba A, Zindi B, Katolola B and Mwangolera A.

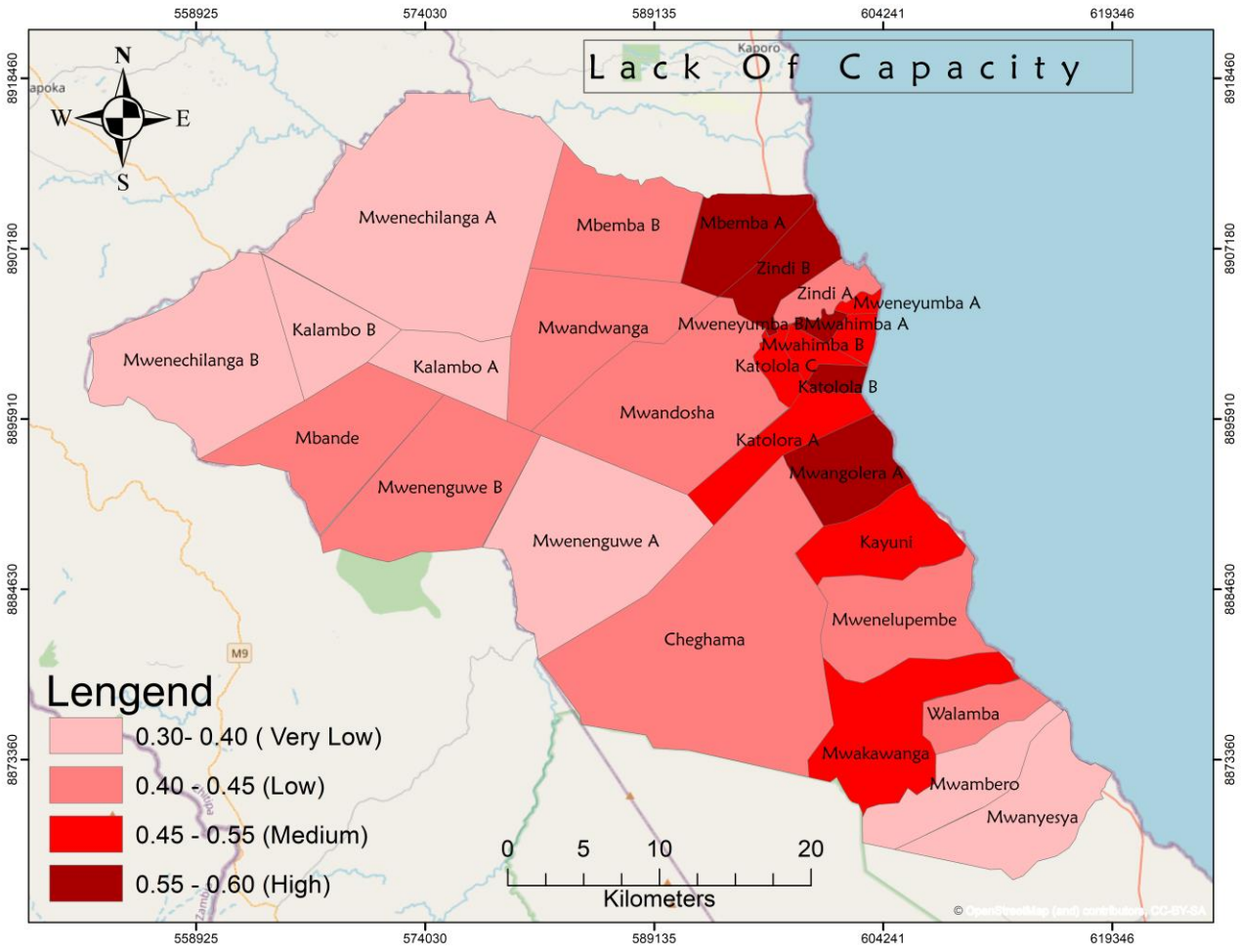


Figure 7. Showing lack of capacity

Figure 9 indicate that there is high susceptibility in Mwahiba A, Katolola B, Katolola C, Kayuni, Mwambero, Mwenenguwe A, Mwenenguwe B and Mwenichilanga B.

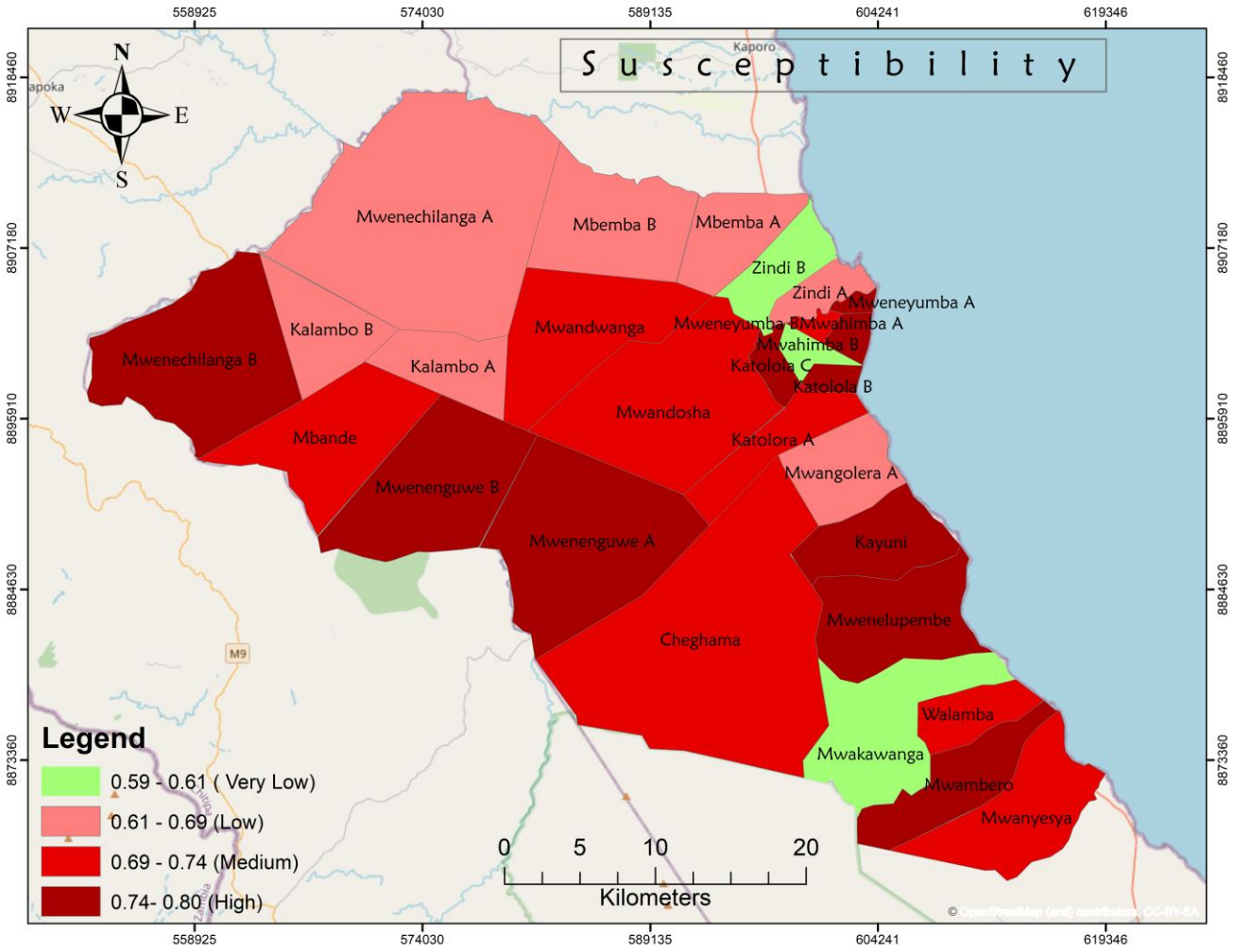


Figure 8. Map showing the level of susceptibility

4.5. Evaluating the effectiveness of existing adaptation and mitigation measures

VDC's around karonga town like Zindi B have strong social capital. There is high level of awareness, participation, and involvement from institutions. That make Zindi more less vulnerable to drought. VDC like Mbemba A and Zindi B as well, they do irrigation system

which help them to harvest twice a year and harvest enough food for their families. As a results, there would be significant gaps in disaster management compared to other commnities. All the above VDC's (Zindi B, and Mbemba A) have high slightly resilience than other VDCs. This could be because these areas are more prone to flooding since they are close to the North Rukuru River, so programs aimed at disaster risk management are more focused on them which boost their capacity and resilience.

Mwangolera, Katolola B and Mweniyumba B have got highest level of lack of capacity. Most organization do not take part in any activities to boost their activities and people suffer a lot and the soil that is found in these VDCs do not keep soil moisture which make the land to dry up quickly when once the rains has stopped raining hence crops dries up. May be the establishment of Green Belt Initiative may help the people from Mwenilondo and Lupembe VDCs to start irrigating their crops and harvest enough for its people.

According to traditional authority Kyungu's evaluation of drought vulnerability in Karonga districts, there are differences in the exposure, susceptibility and capacity of various VDCs. A thorough investigation reveals that some communities have medium degree of risk, but some stand out with higher degrees of vulnerability. Drought vulnerability is high in TA Kyungu and this pattern is consistent throughout the community. Susceptibility, however is a major factor in vulnerability. This runs counter to the widely held theoretical belief that vulnerability is driven by susceptibility in Sub-Saharan Africa (Kamanga et al., 2021). There is little exposure because of limited education and economic challenges. Higher social capacities function on as a moderator against the lack of capacity, economically, emerging nations are characterized by extreme low capacities. Economic empowerment initiatives have the potential to significantly lessen Karonga's susceptibility to drought (IFAD, 2017).

With risk scores ranging from 0.59 to 0.6, the vulnerability assessment conducted across communities reveals that Mwenenguwe A, Mwenichilanga B, Mwenenguwe A and Mweniyumba B are among the most susceptible. Zindi B and Mbemba A, on the other hand, have the lowest vulnerability hand, have the lowest vulnerability levels when compare to other communities.

It is very crucial to quantify vulnerability and frame it in terms of exposure, susceptibility and capacity particularly in developing countries like Malawi where mostly limited resources are allocated. This study attempted to thoroughly evaluate the drought hazard vulnerability in traditional authority Kyungu in karonga district. A more complex region's susceptibility emerged through targeted goals like measuring vulnerability, determining important contributing factors, categorizing vulnerability levels and mitigation strategies.

Policymakers, stakeholders and communities can use the research's insightful findings to create focused interventions and policies that will lessen vulnerability and increase resilience to drought hazard in TA Kyungu.

5.1.0. CONCLUSION AND RECOMMANDATION

A comprehensive vulnerability assessment of drought is essential for policy making in Malawi. It ensures that policies are effective and targeted, resource are optimally utilized and long-term resilience is built. This approach is fundamentals for promoting sustainable development and improving the livelihoods of those affected by drought in the country.

5.1.1. Ex-ante instruments

The government should mostly use some of ex-ante instrument like Contingency Budget line. Where government keep some money in the budget in advance for Vote Unforeseen Expenditure: This help the government to respond quickly to the need of the people during drought and Sovereign insurance against weather-related risk, the Government should purchase sovereign risk transfer against weather related shocks so that people should be compensated once drought threshold is triggered(*Disaster Risk Management Financing Strategy Pdf - Fufuzani Ndi Google*, n.d.).

5.1.2. Enhance disaster risk management

The creation and execution of targeted interventions and policies meant to lessen drought vulnerability ought to be given top priority by stakeholders and policymakers. This entails boosting financing alternative and increasing infrastructure.

5.1.3. Community empowerment

Community can be made more resilient to drought dangers by giving them access to resources, education and skill development. Building local capacity for disaster preparedness, response and recovery should be the main goal of initiatives.

5.1.4. Promotion of Green Initiatives

People should be encouraged to practice afforestation, water harvesting and sustainable land management techniques, initiatives like the green belt initiative can significantly reduce vulnerability of a region to drought. Government have seen the highest level of vulnerability in Mwangolera VDC, have introduced Green Belt initiative which have not yet started operation. This is emphasized in the Sendai framework for DRR where one of the priorities is to Enhancing disaster preparedness for effective response and to build back better in recovery, rehabilitation and reconstruction. So it's good for government to make some commitment to complete that project fast so that people should forget the issue of hunger and concentrate on other developmental issues. In all that it's crucial to promote community involvement in these kinds of projects in order to yield success.

5.1.5. Collaborative partnership

In order to address the complex issues of drought vulnerability, it is essential to establish collaborative partnerships between government agencies, non-government organization and foreign donors. In order to execute effective solution, collaborative initiative can harness resources, experience and knowledge. By putting these suggestions into practice, stakeholders in TA Kyungu within Karonga district can aim to lessen susceptibility anssssd increase resilience to drought hazards, eventually promoting sustainable development and well-being of the community.

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APPENDICES

Appendix 1

	INDICATOR NAME	MBANDE		KATOLOLA A		KATOLOLA B		MWENELEPEMBE		ZINDIA		ZINDI B		MBEMBA A		MBEMBA B		KALAMBO A		KALAMBO B	
EXPOSURE		W	S	W	S	W	S	W	S	W	S	W	S	W	s	w	s	w	s	w	s
Structure	(E1) Rain fed Agriculture	8	2	8	3	8	4	8	2	8	3	8	1	8	2	8	1	8	2	8	2
	(E2)Livestock production	6	1	6	2	6	2	6	2	6	1	6	1	6	1	6	2	6	2	6	1
Economy	(E3) Economy	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1
SUSCEPTIBILITY																					

physical	(S1) Aridity Index	1	4	1	3	1	5	1	5	1	3	1	3	1	2	1	3	1	4	1	3
	(S2) Access to services	1	3	1	3	1	4	1	3	1	3	1	3	1	3	1	4	1	3	1	3
	(S3) Density	1	3	1	4	1	5	1	5	1	5	1	4	1	4	1	4	1	5	1	5
	(S4) Demographicpressure	1	5	1	5	2	4	1	4	1	5	1	4	1	4	1	5	1	4	1	4
Social	(S5)Poverty level	1	5	1	3	1	5	1	5	1	5	1	5	1	4	3	5	1	3	1	5
	(S6) Literacy	1	2	1	2	1	2	1	2	1	2	1	1	1	1	1	1	1	5	1	4
	(S7) Attitude	1	5	1	5	1	5	1	5	1	5	1	5	1	4	1	5	1	5	1	4
	(S8) Community partici pation	1	4	1	5	1	4	1	2	1	1	1	1	1	1	1	1	1	2	1	2
	(S9)Dependency ratio	1	5	1	3	1	5	1	5	1	5	1	5	1	5	1	4	1	5	1	3

	(S10)Average time to health facility (min)	1	5	1	4	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5
	(S11) % of households with family members with chronical illness	1	3	1	2	1	4	1	3	1	3	1	4	1	3	1	2	1	2	1	2
	(S12) % of households dependent on family farm for food	1	3	1	5	1	4	1	5	1	4	1	3	1	4	1	4	1	2	1	3

	(S13)Average number households struggle to find food (range; 0-12)	1	5	1	5	1	4	1	5	1	2	1	3	1	3	1	3	1	5	1	4
	(S14) % of households who do not save crops	1	5	1	4	1	4	2	5	1	2	1	3	1	4	2	5	1	5	1	4
	(S15) Local resource base	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	4	1	4
	(S16) Diversification	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	3	1	5
	(S17) Stability	1	5	1	5	1	5	1	5	1	5	1	5	1	4	1	4	1	5	1	5

	(S18) Environmental	1	2	1	4	1	5	1	4	1	4	1	5	1	3	1	2	1	3	1	4
CAPACITY																					
Physical	(C1) Preventive measures	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	(C2) Water supply infrastructure	1	3	1	3	1	2	1	3	1	2	1	3	1	2	1	2	1	2	1	3
	(C3) Environmental management	1	2	1	2	1	3	1	2	1	2	1	4	1	3	1	2	1	3	1	3
Societal	(C4)Public awareness programes	1	2	1	4	1	4	1	2	1	2	1	4	1	3	1	2	1	3	1	2

	(C5) School curriculum	1	3	1	4	1	4	1	3	1	3	1	5	1	5	1	3	1	3	1	5
	(C6)Public participation	1	1	1	3	1	3	1	3	1	3	1	1	1	1	1	1	1	2	1	2
	(C7) Local risk	1	4	1	4	1	5	1	4	1	4	1	4	1	4	1	3	1	3	1	4
	(C8)Average Crop Diversification index range >0-1	1	5	1	5	1	5	1	5	1	4	1	5	1	5	1	4	1	5	1	5
	(C9)Average Agricultural diversification index Ranges (0.20-1)	1	2	1	2	1	4	1	2	1	4	1	5	1	4	1	3	1	3	1	3

Econo mic	(C10) Local emergency fund	1	1	1	2	1	2	1	1	1	2	1	2	1	1	1	2	1	1	2	1
	(C11)Access to nationa fund	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	(C12) Access to internation al fund	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	(C13) Insurance market	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	(C14) Mitigation loans	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	(C15) Reconstruc tion loans	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	(C16)	1	2	1	5	1	4	1	2	1	4	1	4	1	5	1	4	5	1	1	1

	Public works																				
Management and Institution	(C17) Risk management/emergency	1	2	1	2	1	4	1	2	1	2	1	3	1	3	1	3	1	3	1	2
	(C18) Risk map	1	3	1	4	1	5	1	4	1	1	1	5	1	5	1	3	1	2	1	2
	(C19) Early warning system	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	(C20) Institutional capacity building	1	2	1	3	1	2	1	1	1	1	1	2	1	3	1	2	1	1	1	1
	(C21) Communication	1	3	1	4	1	3	1	2	1	1	1	4	1	5	1	3	1	1	1	1

	INDICATOR NAME	Mwandosha		Mwanddwana		Mwahimba A		Mwahimba B		Katolola C		Mwenichilanga A		Mwenichilanga B		Mwenenguwe A		Mwenenguwe B		Mweniymba A	
Exposure		w	s	w	s	w	s	w	s	w	s	w	s	w	s	w	s	w	s	w	s
Stracture	(E1) Rain fed Agriculture	8	1	8	3	8	4	8	3	8	3	8	3	8	1	8	2	8	2	8	4
	(E2)Livestock production	6	1	6	1	6	2	6	2	6	2	6	2	6	3	6	2	6	1	6	3
Economy	(E3) Economy	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1
SUSCEPTIBILITY																					
Physical	(S1) Aridity Index	1	4	1	4	1	4	1	3	1	5	1	3	1	4	1	5	1	4	1	5
	(S2) Access to services	1	3	1	3	1	3	1	3	1	4	1	3	1	3	1	3	1	3	1	3

	(S3) Density	1	5	1	5	1	5	1	5	1	5	1	4	1	4	1	5	1	5	1	4
	(S4) Demographic pressure	1	3	1	5	1	5	1	3	1	5	1	5	1	5	1	5	1	4	1	4
	(S5) Poverty level	1	5	1	3	1	5	1	2	1	5	1	4	1	5	1	4	1	5	1	5
	(S6) Literacy	1	2	1	2	1	2	1	2	1	3	1	1	1	2	1	2	1	2	1	2
	(S7) Attitude	1	5	1	5	1	5	1	4	1	5	1	5	1	5	1	5	1	5	1	5
	(S8) Community participation	1	2	1	1	1	2	1	2	1	2	1	1	1	2	1	2	1	1	1	3
	(S9) Dependency ratio	1	5	1	5	1	5	1	4	1	5	1	5	1	5	1	5	1	5	1	5

	(S10) Average time to hea lth facility (min)	1	5	1	5	1	5	1	4	1	5	1	4	1	5	1	5	1	5	1	4
	(S11) % of households with faimily member with chronical illness	1	2	1	2	1	2	1	2	1	4	1	4	1	4	1	3	1	4	1	2
	(S12) % of households dependent on family farm for food	1	5	1	5	1	5	1	5	1	4	1	4	1	4	5	1	1	5	1	5

	(S13) Average number households struggle to find food (range; (0-12)	1	3	1	4	1	4	1	2	1	4	1	3	1	4	1	3	1	4	1	4
	(S14) Percentage of house holds who do not save crops	1	4	1	4	1	4	1	2	1	4	1	4	1	5	1	3	1	3	1	4
	(S15) Local resource base	1	5	1	5	1	5	1	5	1	5	1	4	1	4	1	5	1	5	1	5
	(S16) Diversificat	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5

	ion																				
	(S17) Stability	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5
Environment	(S18) Environmental	1	5	1	5	1	5	1	3	1	5	1	3	1	5	1	5	1	5	1	5
CAPACITY																					
Physical	(C1) Preventive measures	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	2
	(C2) Water supply infrastructure	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	2
	(C3) Environmental management	1	2	1	3	1	3	1	3	1	3	1	2	1	1	1	1	1	2	1	3

social	(C4)Public awareness programes	1	3	1	4	1	4	1	4	1	4	1	2	1	1	1	1	2	3	1	5
	(C5) School curriculum	1	4	1	4	1	4	1	4	1	4	1	4	1	3	1	4	1	4	1	4
	(C6)Public participation	1	3	1	3	1	3	1	3	1	4	1	2	1	2	1	2	1	2	1	4
	(C7) Local risk	1	5	1	5	1	5	1	5	1	5	1	5	1	4	1	5	1	5	1	5
	(C8)Average Crop Diversification index range >0-1	1	3	1	3	1	5	1	5	1	4	1	4	1	3	1	4	1	4	1	5
	(C9) Average Agriculturaldiversification index	1	3	1	2	1	4	1	3	1	2	1	2	1	2	1	2	1	2	1	3

	Ranges (0.20-1)																				
Econo mic	(C10) Local emergency fund	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	(C11) Access to national fund	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	(C12) Access to internatio al fund	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	(C13) Insurance market	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	(C14) Mitigation loans	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

	(C15) Reconstruction loans	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	(C16) Public works	1	5	1	5	1	5	1	5	1	5	1	3	1	1	1	3	1	3	1	5
Management and Institution	(C17) Risk management/emergency	1	3	1	2	1	5	1	4	1	5	1	3	1	1	1	4	1	4	1	5
	(C18) Risk map																				
	(C19) Early warning system	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	(C20) Institutional capacity building	1	2	1	3	1	3	1	1	1	3	1	1	1	1	1	2	1	3	1	2

	(C21) Communication	1	3	1	2	1	3	1	2	1	3	1	2	1	2	1	2	1	3	1	3
	INDICATOR NAME	Mweniyumba B		Mwanyesha		Walamba		mwambero		Cheghama		Lupembe kayuni		Mwenilondo		MWAKAWANGA					
Exposure		W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S				
Stracture	(E1) Rain fed Agriculture	8	3	8	2	8	2	8	2	8	3	8	2	8	3	8	3				
	(E2)Livestock production	6	3	6	2	6	1	6	2	6	1	6	3	6	2	6	3				
Economy	(E3) Economy	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1				
SUSCEPTIBILITY																					
	(S1) Aridity	1	5	1	5	1	5	1	5	1	5	1	4	1	4	1	4				

	Index																				
	(S2) Access to services	1	3	1	3	1	3	1	3	1	3	1	3	1	2	1	3				
	(S3) Density	1	5	1	4	1	4	1	4	1	3	1	5	1	5	1	5				
	(S4) Demographic pressure	1	4	1	3	1	5	1	5	1	5	1	5	1	5	1	5				
	(S5) Poverty level	1	5	1	5	1	5	1	5	1	5	1	4	1	4	1	4				
	(S6) Literacy	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2				
	(S7) Attitude	1	5	1	5	1	5	1	5	1	5	1	5	1	4		5				
	(S8) Community partici pation	1	2	1	2	1	2	1	2	1	2	1	1	1	1	1	2				
	(S9)Depe	1	5	1	5	1	5	1	5	1	5	1	5	1	4	1	4				

	dency ratio																				
	(S10) Average time to health facility (min)	1	5	1	5	1	5	1	5	1	5	1	4	1	4	1	5				
	(S11) Percentage of house holds with family member with chronic illness	1	3	1	2	1	2	1	3	1	3	1	4	1	2	1	3				
	(S12) Percentage of house holds dependent	1	4	1	3	1	4	1	4	1	3	1	4	1	3	1	3				

	on family farm for food																				
	(S13) Average number households struggle to find food (range; 0-12)	1	4	1	4	1	5	1	5	1	4	1	5	1	5	1	5				
	(S14) Percentag of house holds who do not save crops	1	4	1	4	1	5	1	5	1	3	1	4	1	4	1	5				
	(S15) Local resource base	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5				
	(S16)	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5				

	Diversification																				
	(S17) Stability	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5				
	(S18) Environmental	1	4	1	4	1	5	1	5	1	4	1	5	1	5	1	5				
CAPACITY																					
Physical capcity	(C1) Preventive measures	1	1	1	2	1	2	1	1	1	2	1	1	1	2	1	2				
	(C2) Water supply infrastructure	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				
	(C3) Environmental manageme	1	5	1	2	1	3	1	2	1	2	1	4	1	5	1	5				

	nt																				
Societa l	(C4)Public awareness programs	1	4	1	2	1	3	1	2	1	2	1	4	1	4	1	3				
	(C5) School curriculum	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4				
	(C6)Public participati on	1	3	1	3	1	1	1	1	1	1	1	3	1	3	1	4				
	(C7) Local risk	1	5	1	2	1	4	1	5	1	4	1	4	1	5	1	4				
	(C8)Avera ge Crop diversificati on index range >0-1	1	5	1	4	1	5	1	5	1	4	1	4	1	5	1	5				
	(C9)Avera ge Agricul tural diversificati	1	5	1	2	1	3	1	3	1	2	1	5	1	5	1	5				

	on index Ranges (0.20-1)																				
Econo mic	(C10) Local emergency fund	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				
	(C11) Access to national fund	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				
	(C12) Access to Internation al funds	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				
	(C13) Insurance market	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				
	(C14) Mitigation loans	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				
	(C15)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				

	Reconstruction loans																				
	(C16) Public works	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5				
Management and Institutional																					
	(C17) Risk management/ emergency	1	2	1	1	1	1	2	1	2	1	1	1	1	2	1	2				
	(C18) Risk map																				
		1	5	1	3	1	3	4	1	1	3	1	4	1	5	1	5				
	(C19) Early warning system	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				
	(C20) Institutional capacity	1	4	1	1	3	1	1	1	2	1	1	3	1	4	1	5				

	building																				
	(C21) Communication	1	3	1	1	3	1	2	1	1	2	1	2	1	3	1	3				

Appendix 2

VDCs	TOTAL VULNERABILITY
Mbande	0.5
Katolola A	0.5
Katolola B	0.58
Katolola C	0.57
Mwenelupembe	0.56
Kayuni	0.56
Zindi A	0.54
Zindi B	0.4
Mbemba A	0.45
Mbemba B	0.52
Kalambo A	0.54
Kalambo B	0.53
Mwandosha	0.49
Mwandwanga	0.5
Mwahimba A	0.58
Mwahimba B	0.51
Mwenichilanga A	0.57
Mwenichilanga B	0.59
Mweniyumba A	0.59
Mweniyumba B	0.55
Mwanyesha	0.55
Walamba	0.52
Mwambero	0.57
Cheghama	0.55

Mwangolera	0.51
Mwenenguwe A	0.6
Mwenenguwe B	0.54
Mwakawanga	0.54

Appendix 3.

VDCs	EXPOSURE	SUSCEPTIBILITY	LACK OF CAPACITY
Mbande	0.28	0.74	0.42
Katolola A	0.42	0.72	0.54
Katolola B	0.5	0.8	0.57
Katolola C	0.42	0.8	0.51
Mwenelupembe	0.34	0.78	0.43
Kayuni	0.4	0.75	0.52
Zindi A	0.36	0.69	0.42
Zindi B	0.19	0.59	0.57
Mbemba A	0.28	0.64	0.56
Mbemba B	0.26	0.67	0.44
Kalambo A	0.34	0.67	0.4
Kalambo B	0.28	0.69	0.39
Mwandosha	0.2	0.73	0.45
Mwandwanga	0.36	0.73	0.45
Mwahimba A	0.5	0.76	0.53
Mwahimba B	0.42	0.61	0.5
Mwenichilanga A	0.42	0.67	0.39
Mwenichilanga B	0.32	0.76	0.3
Mweniyumba A	0.56	0.75	0.55

Mweniyumba B	0.48	0.7	0.59
Mwanyesha	0.34	0.71	0.4
Walamba	0.28	0.72	0.44
Mwambero	0.34	0.78	0.4
Cheghama	0.36	0.72	0.41
Mwangolera	0.42	0.69	0.6
Mwenenguwe A	0.42	0.76	0.39
Mwenenguwe B	0.32	0.75	0.44
Mwakawanga	0.48	0.75	0.6