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Executive Summary

Tanzania is prone to disasters and has a long history of them. The common disasters in Tanzania are epidemics, pests, flood, drought/famine, fire, accidents, strong winds, refugees, conflicts, landslides, explosions, earthquakes and technological disasters. There are a number of disasters that hit different parts of the country, which have adverse effects to the community's life and the infrastructure. Thus, for the government to be able to formulate sound disaster management plans and policies in the country there is a need to assess the degree at which the community is at risk.

The Disaster Vulnerability Assessment Phase two study is aimed at determining the type, location and frequency of the disasters at national and regional level. To identify the current capacity and coping systems (organizational arrangement) at national and regional level. The study also focuses on identifying direct and indirect causes of vulnerability of major hazards, developing a national vulnerability index and mapping out vulnerability of a given hazard in a given district.

The survey employed two approaches; qualitative (look and learn method) and quantitative approach through the use of questionnaire administration. Three sets of questionnaires were designed; one for district level, the other is for village level and the third for household level. The data were collected on specific hazards and the analysis was done on all hazards.

The sample size for the household was set to 2040 while for village was 84 and 42 districts were sampled.

This study identified fifteen different hazards, which occur in the country, which are refugees, earthquakes, fire, floods, major accidents, explosions, conflicts, drought, landslides, pests, epidemics, strong winds, HIV/AIDS and technological hazards. However, the detail study was done for the most common three type of hazards namely, drought, disease outbreak and pests based on agro ecological zones of Tanzania. The idea of using agro-ecological zones is based on the fact that many people in Tanzania still depend on agricultural sector.

The study revealed that the three most occurring hazards at household level are pests (49.9%) (it includes wildlife), Drought (47%) and Disease outbreak (42.9%)

while at the village level the major three hazards are Pests and vermin (57%), Disease outbreak (52%) and Drought (46%) and at the district level the major hazards are HIV/AIDS (90%), Disease outbreaks (88%) and pests and vermin (79%).

The differences in the order of the major hazards between the household, village and district level is due to the differences in the sample sizes, lack of recorded and reliable data at district and village levels and it might be purely due to differences on perception among different levels.

The household hazard data for each zone were estimated to get a generalized occurrence of hazards in each zone. The generalized zone data was then used to produce hazards maps for the three most common hazards.

National Vulnerability index was developed based on hazard assessment, risk assessment and manageability capacities. The Index was used to determine the vulnerability to different hazards and the result for most occurring three hazards was presented in terms of agro ecological zones.

The study reveals that regions, which are most vulnerable to droughts, are Mwanza, Mara, Shinyanga, Tabora, Dodoma, Singida, Arusha, Manyara, part of Mbeya and Iringa. Regions, which are vulnerable to diseases outbreak are Kigoma, Rukwa, Mbeya and Iringa. Morogoro, Ruvuma, Dodoma, Manyara, Tanga, Kilimanjaro, Mtwara and Lindi regions are most vulnerable to pests.

ACRONYM

AIDS	- Acquired Immune Deficiency Syndrome
CBOs	- Community Based Organizations
CCO	- Central Census Office
DAS	- District Administrative Secretary
DMD	- Disaster Management Department
GIS	- Geographical Information Systems
HIV	- Human Immune Deficiency Virus
ILWIS	- Integrated Land and Water Information Systems
JHU	-John Hopkins University
MCE	- Multi-Criteria Evaluation
MoH	- Ministry of Health
NGOs	- Non-Governmental Organizations
PMO	- Prime Minister's Office
RAS	- Regional Administrative Secretary
UNDP	- United Nations for development programmes
UCLAS	- University College of Lands and Architectural Studies
UNDRO	- United Nations Disaster Relief Organizations
WHO	- World Health Organization
VA	- Vulnerability Assessment

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CHAPTER ONE

1 INTRODUCTION

1.1 Background of the Study

1.1.1 Disasters and Disaster Management in Tanzania

Tanzania is located in East Africa between longitude 29º and 41º east and latitude 1º and 12º south. The area of Tanzania is 945,000 sq. km and carries a population of 34.5 million people, out of which 26% lives in the urban areas and the rest in the rural areas. Administratively, there are 21 regions for Tanzania mainland with 113 districts (2002 Census Report).

Tanzania is prone to disasters and has a long history of them. The common disasters in Tanzania are epidemics, pests, flood, drought/famine, fire, accidents, cyclones/strong winds, refugees, conflicts, landslides, explosions, earthquakes and technological disasters (VA I 2001). Different parts of the country experience different disasters due to the difference in physical, social and economic factors together with variation in geographic locations. However, there are no reliable data on vulnerability to these disasters for the government to prepare and put in place the emergence, preparedness and recovery plans. This necessitated the government of the United Republic of Tanzania to conduct a national vulnerability assessment study in year 2001 to find out the areas, which are vulnerable to different disasters with the view to saving people's lives, minimize suffering and disruption to the function of the communities.

The findings of VA I have been successfully used to develop disaster management plans and policies. However, it was revealed that more information is needed to fully assess the level of vulnerability to disasters in the country.

The usefulness and importance of developing plans using concrete data necessitated the government to complement the VA I in areas, which were not included in the first study. Moreover, increased knowledge on the part of the Tanzania population on disasters management called for the need to carry out the VA II. This means such exercise will be done periodically as social economic and technological situation changes.

Following these developments, it was agreed to conduct another study that could capture the information, which was not, covered in phase I. The second study, named Vulnerability assessment phase II, therefore, was designed to complement the findings of phase I and provide adequate information for policy formulation and decision-making.

1.2 Vulnerability Assessment (VA) and the Need for the VA in Tanzania

Disaster management and planning can be viewed as a cycle composed of several phases including hazard analysis, vulnerability assessment, mitigation and prevention, preparedness and planning, prediction and warning response and recovery. Vulnerability assessment is therefore just one of the components in disaster management process.

1.3 Vulnerability Assessment

Vulnerability assessment is the process of estimating the vulnerability to potential disaster hazards of specified elements at risk (UNDP, 1992). Vulnerability assessment involves collecting and analyzing data on four mentioned components of vulnerability. That is the hazards, elements at risk, Characteristics of individuals or communities and Coping Strategies. Depending on the objectives and resource availability, Vulnerability assessment can be done at different levels, from an individual level to household, community, city, district, regional, national or at a global level. Theoretically vulnerability can be assessed as follows (UNDP, 1992)

$$Vulnerability = \frac{\text{Hazard} * \text{Risk}}{\text{Manageability/CopingStrategies}} \qquad (1.1)$$

1.4 The Basic Elements of Vulnerability

Despite many definitions of vulnerability, it can be subdivided into four components, as follows;

1. Hazard

   Hazard is a rear or extreme event in the natural or human made environment that adversely affects human life, property or activity to the extent of causing disaster (UNDP, 1992).

Hazard is a natural or other phenomenon with the potential cause to harm. Hazards are usually characterized by their frequency, speed of onset, magnitude/intensity, duration and area they affect (PeriPeri, Oxfam, 2002)

2. Elements at risk

   This refers to people, resources, services or infrastructure that are exposed to specific threat. Risk in this case is defined as the likelihood that bad things will happen or the expected loss in life, persons injured, property damaged, and economic activity disrupted by a particular hazard. Risk is the probability of a disaster occurring and it resulting in a particular level of loss. While exposure is the degree to which people, livelihoods or property are likely to be struck or affected by a hazard (Periperi, Oxfam, 2002).

3. Characteristics of individuals or communities

   This refers to physical, socio-economic and political factors, which renders individuals or communities defenseless against hazards. Examples of such characteristics include poverty, low levels of education, limited access to power, lack of investment and living in dangerous locations.

4. Community or household resilience, robustness and protectiveness capacities (Manageability or Coping Strategies)

   This refers to on how well the community or household can anticipate, manage, resist or recover from an impact of a threat. These include the physical capacities e.g. appropriate house construction techniques or socio-economic, e.g. accumulation of assets. In other words, the ability of an individual, community or businesses to respond to a disaster. That is the ability of individuals or the society to cope with a given disaster.

1.5 The Need of VA in Tanzania

As Vulnerability assessment is a process of determining the extent at which people, property, environment, natural resources, social and economic activities are at risk, this obliged the government of the united republic of Tanzania to conduct such a study. This study will therefore be used as a tool in disaster management for policy formulation and making evidenced based decisions. Such study will ultimately

provide information, which will be used not only in disaster prevention but also in providing disaster awareness and preparedness.

1.6 Problem Statement and Objectives

There are a number of disasters that hit different parts of the country, which have adverse effects to the communities' life and the infrastructure. Thus, for the government to be able to formulate sound disaster management plans and policies in the country there is a need to assess the degree at which the community is at risk.

The Vulnerability assessment study will form a basis for designing the disaster management plans as the government will then be having all the facts about the real situation as regards to vulnerable communities and infrastructures and therefore plans can be made to provide sound or relevant management strategies as regards to disaster prone areas.

The Vulnerability Assessment Phase II is aimed at

- Determining the type, location and frequency of the disasters at the national and regional level
- Identifying the current capacity and coping systems (organizational arrangement) at national and regional level
- Identifying direct and indirect causes of vulnerability of major Hazards in Tanzania
- Mapping out Vulnerability of a given hazard in a given district
- Developing a national cross case vulnerability analysis report
- Developing a national vulnerability index

1.7 Lessons and Experiences of VA I

From VA I it has been learnt that VA study can be carried out at different levels, i.e. at village, ward, district, regional or at the national level. Therefore in studying VA at a national level data from all levels should be collected.

Basically the findings of VA I indicated that the disaster occurrences in Tanzania are much more associated with location, level of people's awareness, economic level and coping strategies that are put in place. The study further revealed that there are

fifteen major hazards that are commonly occurring in the country, which include, refugees, earthquakes, volcanic eruptions, fire, floods, major accidents, explosions, conflicts/SDP, drought, landslides, pests, epidemics, cyclones/strong winds and technological hazards. However, the study also indicated that the four leading hazards are Refugees, Pests, drought, and epidemics.

It has also been learnt that a lot of data were collected in the VA I using the well designed questionnaires that took into account all important aspects needed in Vulnerability assessment process, however, while analyzing the data much emphasis was given to disaster occurrences and the issue of vulnerability was given less weight.

1.8 Conceptual Framework

The conceptual framework for the phase two vulnerability analysis in Tanzania is based on disaster crunch model by Piers, *et. al.* (1992). See figure 1. The framework has three main components. These are the underlying causes, dynamic pressures, hazards and unsafe conditions

1. **Underlying causes**: a deep-rooted set of factors within a society that together form and maintain vulnerability

2. **Dynamic pressure**: a translating process that channels the effects of a negative cause into unsafe conditions, this process may be due to lack of basic services or provision or it may result from a series of macro-forces.

3. **Unsafe condition**: the vulnerability context where people and property are exposed to the risk of disaster the fragile physical environment is one element; other factors include an unstable economy and low-income levels.

These three components mentioned above when combined together give rise to vulnerability while a disaster is a result of vulnerability and hazard.

A close analysis of the model shows the three components of vulnerability. The underlying cause, dynamic pressures and the unsafe conditions all elaborate the characteristics and coping strategies of the elements at risk.

For the purpose of this study a modification has been made on the model. For the characteristics of elements at risk the underlying causes are called indirect causes and the dynamic pressures are called direct causes.

The source of data for both indirect and direct causes was from the households, village, district and regional offices. The type of data which has been colleted that reflects the characteristic of the district are;

- Direct causes
    - Poverty levels
    - Availability of the natural resources
    - Main economic activities
    - Power structures
- Indirect causes

  Lack of
    - Health facilities
    - Educational facilities
    - Appropriate skills
    - Infrastructure
    - Investment
- Also levels of
    - Population expansion
    - Rate of urbanization

THE PROGRESSION OF VULNERABILITY

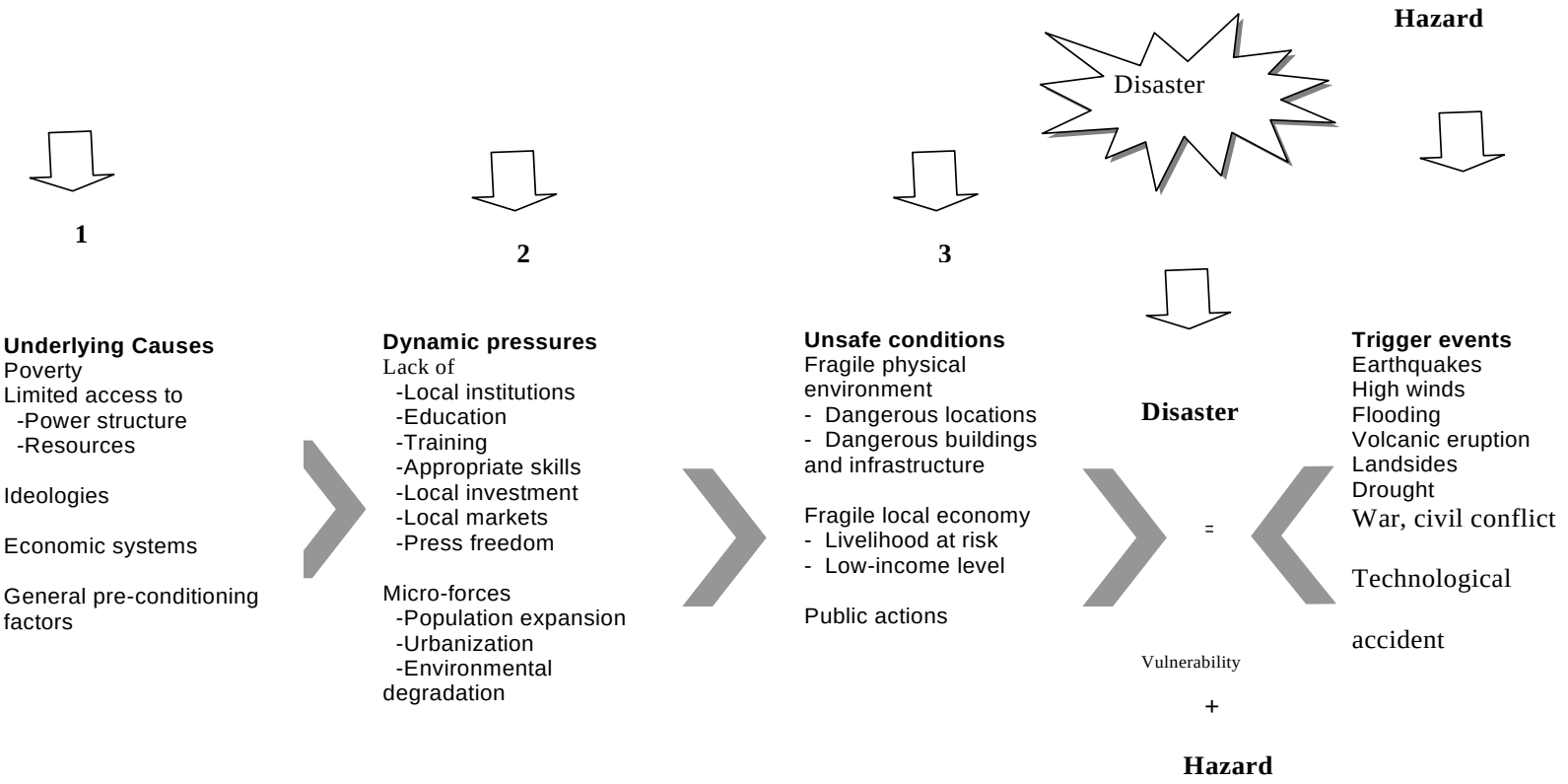

Figure 1: The Disaster Crunch Model, (Piers, et al, 1992)

1.9 Key Institutions and researchers in VA II

The VA II Study drew in different institutions and researchers including

- The University College of Lands and Architectural Studies (UCLAS),
- The Prime Minister's Office – Disaster Management Department (DMD),
- John Hopkins University (JHU) - The Center for Refugees and Disaster Studies

Chapter Two

2 Research Methodology

2.1 Overall research strategy

University College of Lands and Architectural Studies (UCLAS) was commissioned by the Disaster Management Department (DMD) in the Prime Ministers Office to conduct this study. The design of and the structure of this study are based on the terms of reference provided by the DMD (see Annex 2.1).

The survey employed two approached; qualitative (Look and Learn-LL method) and Quantitative approach (through the use of Questionnaire administration). The data were collected on specific hazards and the analysis was done on all hazards. However, detailed analysis was done in the most common three hazards per each district.

The fieldwork was planned to be conducted for seven days in each region. One day at the region for paying courtesy call to the Regional Administrative Secretary (RAS). One day was set for administering the questionnaires to key informants at district level. Another day was used for administering the questionnaires at the Village. In each region four villages were surveyed.

To harmonize the data collection process and ensure the data quality and reliability, all collaborators were trained on the survey protocol for five days. Experts who were not familiar with disaster management and who participated in this research were also trained on the concepts of disaster management for two days at UCLAS (see Annex 2.2)

In order to improve the sampling techniques, bearing in mind the technological development and socio economic level of Tanzania, the agro ecological zones were used in the design phase and consequently in the analysis. It is also important to mention that the selected sample size took into account the seven-agro ecological zones and findings have been aggregated based on the same zones.

As vulnerability assessment can be done at different levels, such as household, village, ward, district, region or country, which are all location specific, mapping these areas is of paramount importance. To accommodate this aspect Geographical Information Systems (GIS) was used.

2.2 Pre-Field Work

Prior to going to the field for data collection some preliminary works were done in the office. These included the collection of secondary data such as population and maps, preparation of the survey instruments, identification of the key informants, selection of data collectors, training of the data collectors and researchers and doing literature review on disasters, vulnerability, hazards and risks. Pre-testing of all the research tools were also done before the fieldwork commenced.

2.3 Literature review

There is a wealth of information in the offices and archives of many important emergency and disaster institutions. Documents were sought from different institutions such as, Central Census Office (CCO), National Bureau of Statistics, Ministry of Health, Ministry of Lands -Survey and Mapping Division and other relevant Institutions.

In order to properly conceptualize the term vulnerability assessment the terms related to vulnerability analysis are to be clearly understood. These are disaster, hazard, vulnerability and risks. However, there is no single definition of these terms, different professionals have defined them in different ways.

The United Nations Disaster Relief Organizations (UNDRO, 1991) defines disaster as a serious disruption of the functioning of a society, causing widespread human, materials or environmental losses, which exceeds the ability of the affected society to cope, using only its own resources. Disaster is often classified according to their speed of onset (sudden or slow) or according to their causes (natural or man made).

While the World Health Organization (WHO, 1990) defines the term disaster as any occurrence, which causes a damage, ecological disruption, loss of human lives, deterioration of health and health services on a scale of sufficient to warrant an extra ordinary response from the affected community.

Gunn (1990) defines disaster as a result of vast ecological breakdown in the relations between man and his environment as serious and sudden event (or slow as drought) on such a scale that the stricken community needs extraordinary effort to cope with it, often with outside help or international aid.

Davis (1990) says that disaster is the product of the impact of a natural event upon a vulnerable population to cause disruption damage and causalities beyond the unaided capacity of locally mobilized resources.

The UNDP expressed mathematically this definition of disaster as follows;

$$D = \frac{H * V}{M} \qquad (2.1)$$

Where,

D = disaster

H = hazard

M = manageability

V = vulnerability

Hazard is a natural or human caused event that could cause loss of life or damage to property and environment. Hazard includes earthquakes, storms, drought, fire, strong winds, floods, volcanic eruptions, war, major accidents, etc. A hazard becomes a disaster when it strikes vulnerable people

Manageability refers to the degree to which a community can intervene and manage a hazard in order to reduce its potential impact .the term comes from the word 'Manage'; Manageability therefore refers to the extent to which a particular hazard can be manageable.

Robert Chambers defines Vulnerability as:

Defenselessness, insecurity and exposure to risk, shocks and stresses… and difficulty in coping with them. Vulnerability has two sides: an external side of risks, shocks and stress to which an individual or household is subject and an internal side which is defenselessness, meaning a lack of means to cope with damaging loss.

Periperi, Oxfam (2002) define Vulnerability as:

The characteristics that limit any individual, a household, a community, a city, a country or even an ecosystem's capacity to anticipate, manage, resist or recover from an impact of natural or other threat (often called "hazard" or natural "trigger")

UNDP, (1992) define Vulnerability as:

The degree of loss (for example from 0 to 100 percent) resulting from a potentially damaging phenomenon.

Elements at risk

This refers to people, resources, services or infrastructure that is exposed to specific threat. Risk in this case is defined as the likelihood that bad things will happen or the expected loss in life, persons injured, property damaged, and economic activity disrupted to a particular hazard. Risk is the probability of a disaster occurring and it resulting in a particular level of loss. While exposure is the degree to which people, livelihoods or property are likely to be struck or affected by a hazard (periperi, Oxfam, 2002).

Characteristics of individuals or communities

This refers to physical, socio-economic and political factors, which renders individual or communities defenseless against hazards. Examples of such characteristics include poverty, low levels of education, limited access to power, lack of investment and living in dangerous locations.

Community or household resilience, robustness and protectiveness capacities (Manageability or Coping Strategies)

This refers to how well the community or household can anticipate, manage, resist or recover from an impact of a threat. These include the physical capacities e.g. appropriate house construction techniques or socio-economic, e.g. accumulation of assets. In other words, the ability of an individual, community or businesses to respond to a disaster. That is the ability of individuals or the society to cope with a given disaster.

2.4 Vulnerability Assessment

Vulnerability assessment is the process of estimating the vulnerability to potential disaster hazards of specified elements at risk. Vulnerability assessment involves collecting and analyzing data on four mentioned components of vulnerability. That is the hazards, elements at risk, Characteristics of individuals or communities and Coping Strategies. Depending on the objectives and resource availability, Vulnerability assessment can be done at different levels, from an individual level to household,

community, city, district, regional, national or at a global level. Theoretically vulnerability can be assessed as in equation (1.1)

2.5 Developing the Research Tools

Research tools were developed for data collection and analysis. Three Sets of Questionnaires (households, village, district) were developed and pre tested before going to the field. Checklists were also prepared to guide the data collection process, especially in discussions with the key informants at the district and village levels.

The Questionnaires and checklists were first written in English and then translated in Swahili language. The idea of translating the questionnaire into Swahili was to ensure consistency, common understanding of the questions and hence to avoid distortion of the meaning of the questions during the interview.

District maps were also prepared for those districts, which were involved in the data collection.

2.6 Sampling Protocol Development

2.6.1 Sampling Design

Sample surveys are distinguished from other statistical collection by their particular approach to two questions. The first one concern with the units of the population to be surveyed before sample selection. The second one relates to how relevant conclusions including estimates concerning the population survey is to be inferred from the data collected. Sampling theory is concerned primarily with the answer to these two questions.

The results of sample surveys are always subject to some uncertainty because only part of the population has been included and because of measurements errors. Simply increasing the sample size cost both in terms of time and money; hence, the specification of the degree of precision wanted in the results is an important consideration step.

2.6.2 Sample Size

The sample size sufficient to make inference at national level was based on the calculations performed taking into account the following facts: -

- The total number of households in mainland Tanzania (based on 2002 census) is 6,811,087.
- The degree of precision; this is the acceptable level (in probability) that the absolute difference between the true parameter and the estimate is greater than some specified value. In this study the degree of precision was taken to be 2.5%.
- 95% confidence interval; this is the probability that the procedure yields an estimate which out of 100 such intervals, 95 of them will cover the true parameter.
- The population characteristic(s) of interest was regarded to be of categorical in nature.
- The design effect; which is the ratio of the variance of the proportion estimator based on the complex design employed to the variance of the same estimator under simple random sampling of the same size. In this case the design effect was taken to be 1.3.
- The value of Population percentage (P) is not known in advance. Hence the conservative choice of 50% was made to ensure the maximum sample size required.
- Provision for non-response; there is a possibility that some households might refuse to participate in the survey. To compensate for this, it is important to sample more households than are actually needed to achieve the required number of successful interviews. In this study, we assume the response rate to be 95%
- Based on the facts above, the sample size was set to 2040. The estimated sample size shall yield estimates of population parameters at national level, for regional and district specific estimates one has to re-estimate the regional and district specific sample size. The allocation of number of interviews conducted per region is given in Annex 2.3

- In summary, multistage sampling was the best way to get access to households. The stratifications by zones had an effect of increasing precision. The choice of this design enable respondents to be sampled from abbreviated listings and hence field workers' travel was correspondingly reduced. Details of the actual selection of the multistage sample is given in Annex 2.4

2.6.3 Steps in selection of Districts

The following are factors, which were used in selecting the districts, see also Annex 2.4

- Each region was represented by two districts
- Each of the 7 agro-ecological zones within mainland Tanzania was represented proportionally in the sample (Annex 2.4).
- The ratio of the districts perceived to be prone to disaster to those, which are not, was 60:40.
- Lastly, 60% of the sampled districts were those not surveyed in the VA I, while 40% were those surveyed in VA I

2.6.4 Steps in Selection of Wards

- At district level, wards were grouped into two groups, those in rural and urban.
- The names of wards were ordered serially in each group
- Each serial number was written on a separate piece of paper. The papers were similar in colour, size and texture
- The papers were folded and mixed thoroughly
- One piece of paper was select randomly and the corresponding ward in the sample was obtained; thus in each group, one ward was randomly selected. The idea was to cover both settings.

It should be noted that, the selected ward took half of the interviews allocated at district level

2.6.5 Steps in Selection of Villages

- At ward level, the names of villages were ordered serially
- Each serial number was written on a separate piece of paper
- The papers were folded and mixed thoroughly
- One piece of paper was selected randomly to get the corresponding village in the sample.

2.6.6 Steps in Selection of Households

- Sufficient random numbers were generated. The generated numbers were sealed in an envelope for every village and given to researchers. Statisticians had to perform this exercise.
- List of households submitted by the Hamlet leaders was combined and ordered serially.

The sealed envelope given in step1 was opened, from the sequence the first random number was picked and the household with the serial number corresponding to the number picked was obtained. This household was then included in the sample. In case the number picked from a sequence of random did not correspond to any number in serial arrangement of households or was already picked earlier, the second number in the list of random numbers was picked. This step was repeated until the required number of households was attained. For every household selected the reference person was contacted for the interview.

2.6.7 Selection of Households for Replacements in case more than 5% of the Sampled Households Refused to Participate

- A team leader in the field had to perform these steps.
- The list of households were serially reordered ignoring the ones already interviewed, and those refused.
- Write each serial number on a separate piece of paper
- Fold the papers (blinding) and mix them thoroughly
- Select randomly without replacement the pieces of paper until s/he had the required number.
- Unfold the selected numbers and interview the corresponding households. This is the replacement of those refused.

2.7 Data Collection Strategy /Plan

Data for this study was primarily collected by two data collectors for each region, one from the region (regional disaster focal officers) and the other was a trained researcher from Dar es Salaam. The researcher was appointed as a supervisor for the data collection process. The responsibility of the supervisor was to ensure the overall quality

of the data and was required to submit all the collected data to UCLAS (see terms of reference for data collectors and supervisors in Annex 2.5)

2.8 Development of National Vulnerability Index

In developing the national vulnerability index, the country was divided into 7 agro ecological zones. Generalized linear modes were used to estimate the vulnerability of each individual or groups to a specific hazard. To estimate the level of vulnerability of a particular zone for a specific hazard, probabilities of individuals or groups within a zone were averaged. The appropriate logistic regression model, which entails model selection process, was developed and the resulting zones' probabilities were used to develop the national cross case vulnerability report and mapping the zones.

2.9 Pre-Testing of Research Tools

The purpose of pre-test was to evaluate the instruments and some of the logistical operational and procedural aspects of the survey. Another purpose was to estimate the time taken in administering the tools per respondent so that this information could be used to determine whether there was a need to review the planned duration of survey.

Dar es salaam region was used for pre-testing. Chamazi ward, which is located in Temeke district, was selected as a sample ward for the pretest. The selected Villages were Kurasini, which represented the urban setting, and Mbande, which represented a rural setting.

The pretest outcome enabled the modifications of the questionnaires especially on the sequences of the questions, setting of new codes and re-wording of some questions to make them clearer. The pretest was also used to estimate the time that was taken in administering the tools per respondent so that realistic field plans could be formulated.

2.10 Fieldwork Experiences

After successful completion of the fieldwork survey, the supervisors submitted the questionnaires and all other research tools to UCLAS for further analysis. A two days workshop was conducted for researchers to deliberate on what actually they experienced in the field during the data collection process.

Generally, the fieldwork exercise was successfully completed within the time frame as planned. The experience showed that in each region, the survey took a minimum of

seven and a maximum of ten days. There were 12 researchers who participated in the data collection exercises and a regional focal officer in the each region assisted each researcher.

In the debriefing session among others, researchers discussed the field work logistics, the problems that cropped up during the data collection process and how they were able to handle them, strength and weakness of the whole data collection plan, and the general picture of the disaster, hazards, vulnerability and copying strategies for each hazard in the respective regions they visited.

Summarizing all of their observations, very few regions had problems in logistics but researchers were able to resolve such problems. In General it was observed that people (respondents) in each region were very comparative and willingly to provide the required information.

Basically, the documented findings of the field experience from the workshop were used as an input to supplement the information obtained from the quantitative analysis.

2.11 Post Fieldwork

2.11.1 Data cleaning, Coding and Entry

After completion of the data collection process, all the data were pooled out together for cleaning. In this stage, the main objective was to scrutinize the completed questionnaires to identify and minimize errors, incompleteness, misclassifications and gaps in the information obtained from the respondents and code consistency.

Having cleaned the data, the next stage was data coding. Each questionnaire (Households, village, district) was given a unique code for identification to facilitate references.

2.11.2 Data Processing and Analysis

Qualitative and Quantitative approaches were used in the data processing. In quantitative approach both statistical and GIS tools were used. Statistical packages such as S-Plus, R, SAS and StatXact were used in analyzing data.

In the same stage, spatial data were analysed using ILWIS (3.0) and ArcView GIS (3.1) GIS software packages. Multi-Criteria Evaluation (MCE) technique was used to

determine the vulnerable areas by making use of vulnerability indicators, scores and the weights for a given hazard.

In qualitative data analysis approach a two days workshop was organized to deliberate upon the following.

- Brainstorming to get more analysis of why, how and when people, property and natural resources are vulnerable to particular disaster,
- To identify issues/factors that make people vulnerable to disasters
- In each case who are the most vulnerable groups (e.g. women, men, children, youth or disables) when and why are they vulnerable?
- What factors do people perceive that make them vulnerable?
- For each individual or groups, which copying strategies are used to deal with the disasters?
- Why are the different individuals or groups are using those copying strategy and why do they differ?
- How are these copying strategies related to their life skills?
- How are the copying strategies related to policies in force?
- Are the policy strategies seen to have been changing over time?

At the end of the two days workshop most of the qualitative data were collected based on these guiding questions.

CHAPTER THREE

3 Research Findings

This chapter will dwell on the main research findings including the physical aspects, socio-economic situation and infrastructure, hazard occurrences, causes, impacts, hazard manageability and coping strategies. The dataset has been analyzed at three levels which are household, village and district.

3.1 The Physical Aspects

As stated earlier, sampling was done by considering among other things agro-ecological zones of Tanzania. The classification of these zones is based on physical characteristics, that is, altitude, precipitation, soils and physiographic aspects. The data for agro ecological zones were extracted from the 1983 agro-ecological zones map. The idea of using agro-ecological zones is based on the fact that many people in Tanzania still depend on agricultural sector.

3.2 Agro-Ecological Zones

Based on altitude, precipitation pattern, dependable growing season, average water holding capacity of the soils and physiography, Tanzania has a total of 49 agro ecological zones, which can be generalized, into 7 main zones. These are Coastal, Eastern plateau and mountain blocks, Southern highlands, Northern rift valley and volcanic high lands, Central plateau, Rukwa-Ruaha rift zone and inland sedimentary plateau, Ufipa plateau and western highlands. Figure 3.1 and show the distribution and details of the characteristic of each zone respectively.

Figure 1 Agro-ecological zones of Tanzania

Table 3-1 Characteristics of the Agro-Ecological Zones

S/N	Zone	Altitude m/sea level	Precipitation pattern	Dependable growing season in months	Physiographic
1	Coastal (C)	< 100 to 500	Bimodal and monomodal	3 to 10	Combination of coastal lowlands, uplands, undulating and rolling plains
2	Eastern plateau and mountain blocks (E)	200 to 2000	Predominantly monomodal	From < 2 to 7	Many physiographic types, ranging from flat areas, undulating and rolling plains, hilly mountain, plateau to mountain blocks
3	Southern highlands (H)	1200 to 2700	Monomodal	5 to 10	Composed of flat to undulating rolling plains and plateau, hilly areas and mountains
4	Northern rift valley and volcanic high lands (N)	900 to 2500	Monomodal	< 2 to 9.5	Ranges from flat to undulating plains, hilly plateau to volcanic mountains
5	Central plateau (P)	800 to 1800	Monomodal	2 to 6	Composed of flat plains, undulating plains, plateau and some hills
6	Rukwa-Ruaha riftzone (R)	800 to 1400	Monomodal	3 to 9	Composed of flat terrain, rocky terrain and complex terrain
7	Inland sedimentary plateau , Ufipa plateau and western highlands (SUW)	200 to 2300	Monomodal	3 to 9	Composed of undulating plateau, strongly dissected hills, dissected hilly plateau and undulating rolling plains.

Source: Tanzania Agro-ecological zones map, 1983

3.3 Distribution of Districts in Relation to Agro-Ecological Zones

The distribution of districts for each zone is indicated in Table 3.2. The majority of the districts are located in central plateau zone (31%), eastern (18%) and coastal zone (15%). The details that indicate the names of districts in each zone are given in appendix 3.1

Table 3-2 The distribution of Districts in Each Zone

AGROECOLOGICAL ZONES	TOTAL DISTRICTS	% DISTRICTS	NUMBER OF DISTRICTS SAMPLED
C	17	15	6
E	20	18	7
H	10	9	4
N	13	12	5
P	35	31	13
R	7	6	3
SUW	11	10	4
Total	**113**	100	**42**

3.4 Socio- Economic Aspects

The socio-economic aspects were looked at three levels household, village and district The socio-economic parameters that have been looked at are the population characteristics, development indicators, main economic activities, water supply services and availability of key facilities.

3.4.1 Population Characteristics

At the household level the average household size was 7. The composition of males and females in the entire sampled households was 48% and 52% respectively, whereas children under 5 years were 17% and disabled people were 8%. At the village level, the average number of people per sampled villages was 3657.

3.4.2 Main Economic Activities

At household level, majority of respondents (86%) reported agriculture to be their main economic activity, followed by livestock (29%), trade (23%), formal employment (12%) and fishing (3%). Table 3.3 and Figure 3.2 show the details of economic activities. At village level, the major economic activity was agriculture (67%), followed by livestock and business activities at 13% each, formal and industrial employment, each constituted 2% whereas fishing activities only account for 1%.

Based on the information at the household level, it appears to be a difference in the level of activities between rural and urban areas; for example, more agricultural activities are practiced in rural areas than urban areas. See Figure 3.2. However, when these differences were tested using formal statistical methods, the difference was found not to be significant (Z-value for Wilcoxon Signed Rank Test =0.4045; p-value=0.8). One possible explanation for this is due to the fact that people move to urban areas to seek social services but continue to engage in agricultural activities.

The main sources of income at household level are agriculture, which contributes 70% of total household income, trade 9%, employment 8%, livestock, 5% and others 6%.

Table 3-3. Main Economic Activities at the Household Level

	Activities	National Estimates	Rural (%)	Urban (%)
		%		
1	Agriculture	86 (1718)	89.40	81.02
2	Formal Employment	12 (233)	9.53	15.03
3	Trade	23 (466)	22.29	25.10
4	Fishing	3 (60)	2.65	3.57
5	Livestock	29 (581)	31.73	25.22

Note: values in bracket represent the number of respondents

The percentages do not sum up to 100 because multiple response were allowed

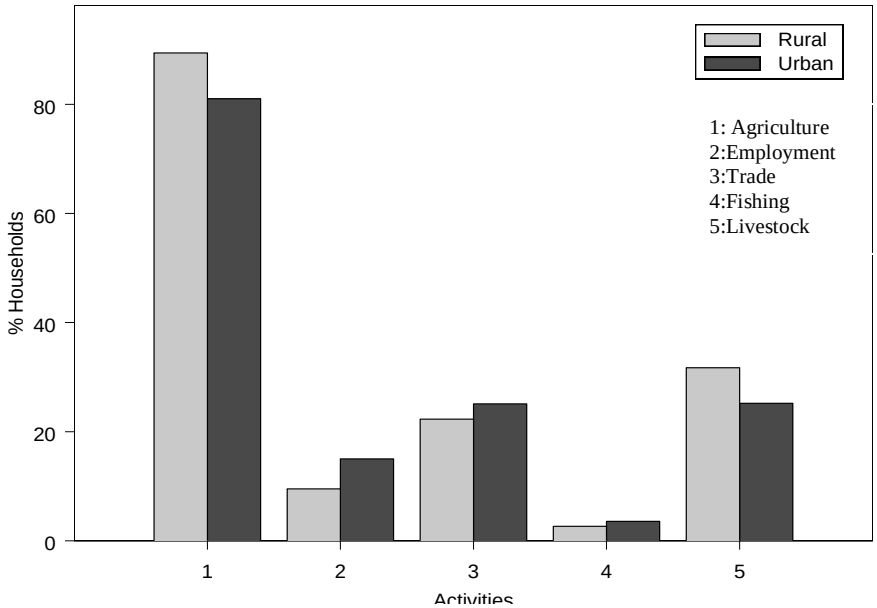

Figure 2 Main Economic activities at Household

At district level, agriculture still contributes a larger portion of income (60%), followed by livestock keeping (15%), commerce (16%), government employment (5%), fishing (6%) and industrial employment at 3%.

3.4.3 Water Supply Services

Based on the household data, the majority (62%) of the households still depend on traditional sources of water supply. The study also revealed that 26% of households use wells as the main source for water supply, 24% get their water from rivers, 9% harvest rainwater and 6% use lakes. Only 38% of the households are currently supplied with piped water.

The data collected at village level show that 24% of the villages have access to piped water supply. However, when looking at the sources of water, the majority of villagers (43%) are getting water from shallow wells, 39% depend on river water, 18% depend on deep wells, 11% depend on depends on lakes while only 4% depend on rainwater harvesting. At the district level, 32% depend on rivers and wells, 8% on lakes, 5% on rainwater harvesting. However, it should be noted that majority of respondents use more than one source of water.

Focusing on rural and urban settings, it was found that at household level, 28% of households use wells in rural areas and 22% use wells in urban. 31% of households in rural and 50% in urban areas use piped water supply. When looking at the main sources of water, 27% of households in rural areas use rivers whereas 18% in urban use this source of water.

The average distance to water sources ranges from less than a kilometer to slightly above 1 kilometer. The average shortest distance is to the tape water, which is 0.7 of a kilometer. Rivers are located furthest on average among the sources of water (1.3 km).

Combining information at all three levels; household, village and district, it can be said that two thirds of people in Tanzania still depend on wells, river, rainwater and lakes for water supply. It is only one third of population, which is served by piped water.

3.4.4 Socio-Economic Infrastructure

The information on the availability of the infrastructure in terms of schools, bridges, dams, industry was asked at the village and district levels only. The five common socio-

economic infrastructures at the village level are schools, which 85% of villages have at least one, followed by public buildings (66%), wells (44%), bridges (33%) and dams (23%) Table 3.4 gives the details of socio-economic infrastructure at the village level.

Table 3-4 Socio-Economic Infrastructure at the Village Level

Critical Facility	Number of villages with at least 1 socio-economic facility	% of Village
Schools	70	85
Bridges	27	33
Railway station	4	5
Dams	19	23
Water Sanitation Systems	1	1
Sewage Systems	0	0
Airports	1	1
Industries	8	10
Wells	36	44
Police Stations	8	10
Public Buildings	54	66
Fire Fighting Vehicles	3	4

At the district level, schools were still the dominant socio-economic facilities, with each district having an average number of schools (including primary, secondary and colleges) per 100,000 persons equal to 41 while the average number of dams and bridges per 100,000 persons is 4 and 7 respectively. Table 3.5 shows the details of socio-economic infrastructure at the district level.

Table 3-5 Socio-Economic Infrastructure at the District Level

Type of Facility	**Number of Districts Responded**	**Mean per 100,000**
Schools	40	41
Bridge	33	7
Railway station	17	1
Dams	31	4
Water sanitation systems	22	1
Airports	32	1
Industry	27	3

3.5 Hazard Occurrence and their Causes

In this section hazard types, occurrences and their distributions are analyzed. However it should be noted that hazard occurrences at the household and village level are mostly based on perceptions while hazard occurrences at the district level are mostly based on records. The scope and level of details sought on hazard and disaster management were different for three levels. The hazard parameters studied included types of hazards, timing, frequency, causes and impacts on people and property.

3.6 Hazard Occurrence at Household Level

At the household level, the parameters, which were looked at, are types, timing, causes, impacts and manageability of hazards. At this level a total of 15 types of hazards were identified. The study revealed that the three most occurring hazards are pests and wild animals in which 50% of the respondents perceived that it was a problematic hazard, drought (47%) and disease outbreaks (43%). It should be noted that even though refugees does not appear as a major hazard at the national level, it is one of the key problems in Kigoma Region where by 40% of the households indicated refugees to be a problematic hazard.

Pests in the context of this research include vermin, plant diseases due to fungus or other organisms. Table 3.6 and Figure 3.3 gives the details of perceptions of problematic hazards at household level. Note that hazard codes in figure 3.3 corresponds to hazards in Table 3.6

Table 3-6. Disaster Occurrences (Based on Household Data)

S/N	Type of hazard	Estimates in %
1	Major accidents	1.10 (22)
2	Conflicts	3.16 (63)
3	Cyclones	8.42 (168)
4	Drought	**46.97 (937)**
5	Earthquakes	7.12 (142)
6	Disease outbreak	**42.91 (856)**
7	HIV/AID	16.34 (326)
8	Fire	5.96 (119)
9	Floods	13.18 (263)
10	Landslides	3.76 (75)
11	Technological hazards	0 (0)
12	Pests	**49.87 (995)**
13	Refugees	1.50 (30)
14	Volcanoes	0.05 (1)
15	Explosions	0.15 (3)

Note: values in bracket represent the number of respondents

The percentages do not sum up to 100 because multiple responses were allowed

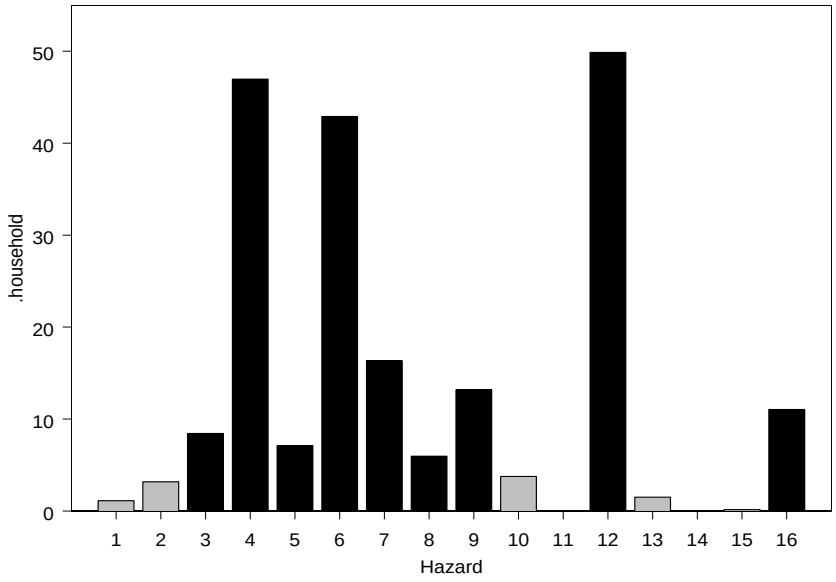

Figure 3 National Disaster occurrence (Based on Village Data)

3.6.1 Hazard Occurrence at Village Level

The major three hazards based on village data are pests, which were perceived to be problematic in 57% of the villages. Others are disease outbreak (52%) and drought (46%). Table 3.7 and Figure 3.4 show the details of the hazards.

Table 3-7 National Disaster Occurrences (Based on Village Data)

S/N	Hazard Type	% of Villages
1	Major accidents	7.32 (6)
2	Conflicts	3.66(3)
3	Cyclones	7.32(6)
4	Drought	46.34(38)
5	Earthquakes	2.44(2)
6	Disease outbreak	52.44(43)
7	HIV/AID	37.80(31)
8	Fire	9.76(8)
9	Floods	15.85(13)

10	Landslides	4.88(4)
11	Technological hazards	0.00(0)
12	Pests	57.32(47)
13	Refugees	2.44(2)
14	Volcanoes	0.00(0)
15	Explosions	1.22(1)
16	Others	15.85

Note: values in bracket represent the number of villages which reported the hazard

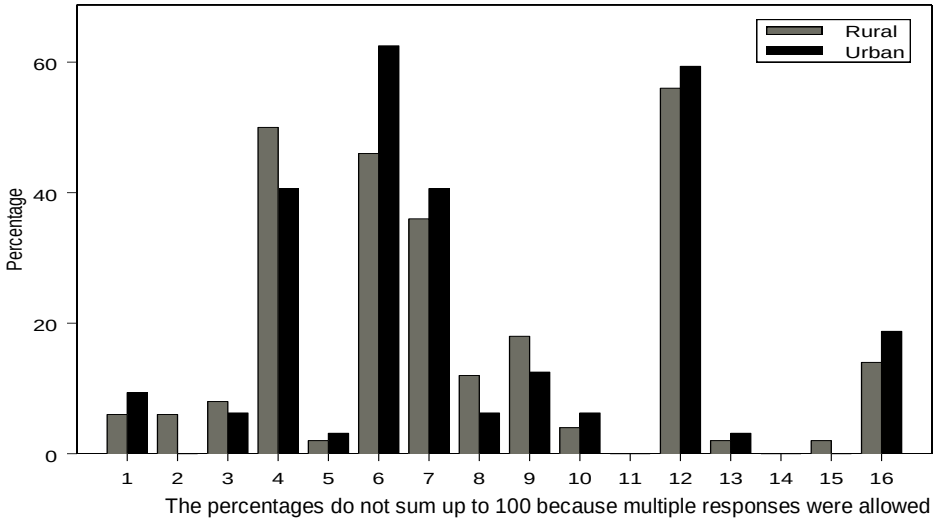

Figure 4 National Disaster occurrence (Based on Village Data)

3.6.2 Hazards Occurrence at District Level

Data collected at district level were mostly based on records. The study shows that there is a difference in order of hazard occurrences at the district level when compared to lower levels. See Table 3.8 for details. HIV/AIDS together with disease outbreaks become the most common hazards in which 57% of the sampled districts indicated them as problematic hazards. Followed by, pests and vermin (52%), drought (35%), and strong winds (14%).

Table 3-8 National Disaster Occurrences (Based on District Level)

S/N	Type of hazard	Estimates in %
1	Major accidents	**57**
2	Conflicts	24
3	Cyclones	60
4	Drought	71
5	Earthquakes	40
6	Disease outbreak	88
7	HIV/AID	90
8	Fire	74
9	Floods	50
10	Landslides	21
11	Technological hazards	10
12	Pests	79
13	Refugees	19
14	Volcanoes	4
15	Explosions	12
16	Others	35

The differences in the order of the major hazards between the data collected at district level and grass root levels i.e. household, village is not surprising. This can be attributed to a number of different reasons. First, the household and village data is based on perceptions while the district data is based mostly on records. Second, it can be due to the differences in the sample sizes among the three levels. Third, lack of recorded and reliable data at district. Fourth, it can purely be due to the differences on the perceptions among different levels on major hazards with each level focusing on issues they are supposed to deal with daily. At the village level the focus is more on agricultural related hazards, while at the district level they are dealing with both agricultural and more urban related issues such as fire. The other reason can be to due to openness in responding to sensitive questions. At the household level people are probably less open to respond

to personal and sensitive issues, such as HIV/AIDS than at the village or district level. That is why probably HIV/AIDS hazard is comparatively lower at the household level.

3.6.3 Estimates of Hazard Occurrences at the Zonal Level

The household data were used to estimate the occurrences of hazards at zonal level. Table 3.9 and Figure 3.4(a) show the estimated occurrences of each hazard in the zones. Using drought as an example, its occurrence is highest in zone 4, where 79% of the households mentioned it to be a problematic hazard. This was followed by zone 5 (58%), zone 6 (43%), zone 7 (40%), zone 2 (39%) and lastly zone 4. The estimated zonal data were then used to produce hazard maps for the three most problematic hazards.

Table 3-9 Estimates of Hazard occurrence at Zonal Level

Hazards	Zones (%)						
	1	2	3	4	5	6	7
1	1.63	0	2.26	0.39	0.69	1.27	1.53
2	7.08	0.00	7.10	1.56	1.55	2.53	0.00
3	1.91	25.00	11.94	3.91	6.91	1.27	10.71
4	31.06	38.94	30.00	78.91	57.69	43.04	40.21
5	0.27	16.35	22.26	3.52	2.42	0.00	7.65
6	21.80	37.50	37.10	59.83	59.59	65.82	17.35
7	1.63	11.54	1.94	5.08	33.16	17.72	36.22
8	5.72	1.92	2.26	0.78	7.25	25.32	11.73
9	15.53	4.81	27.10	26.56	3.80	5.06	9.18
10	10.63	0.48	5.16	7.03	0.00	0.00	0.51
11	0	0	0	0	0	0	0
12	44.69	72.60	58.71	53.91	41.80	18.99	52.55
13	0	0	0	0	5.18	0	0
14	0	0	0	0	0	1.27	0
15	0	0.48	0	0	0.35	0	0
16	12.26	17.31	1.94	12.11	11.92	36.71	2.04

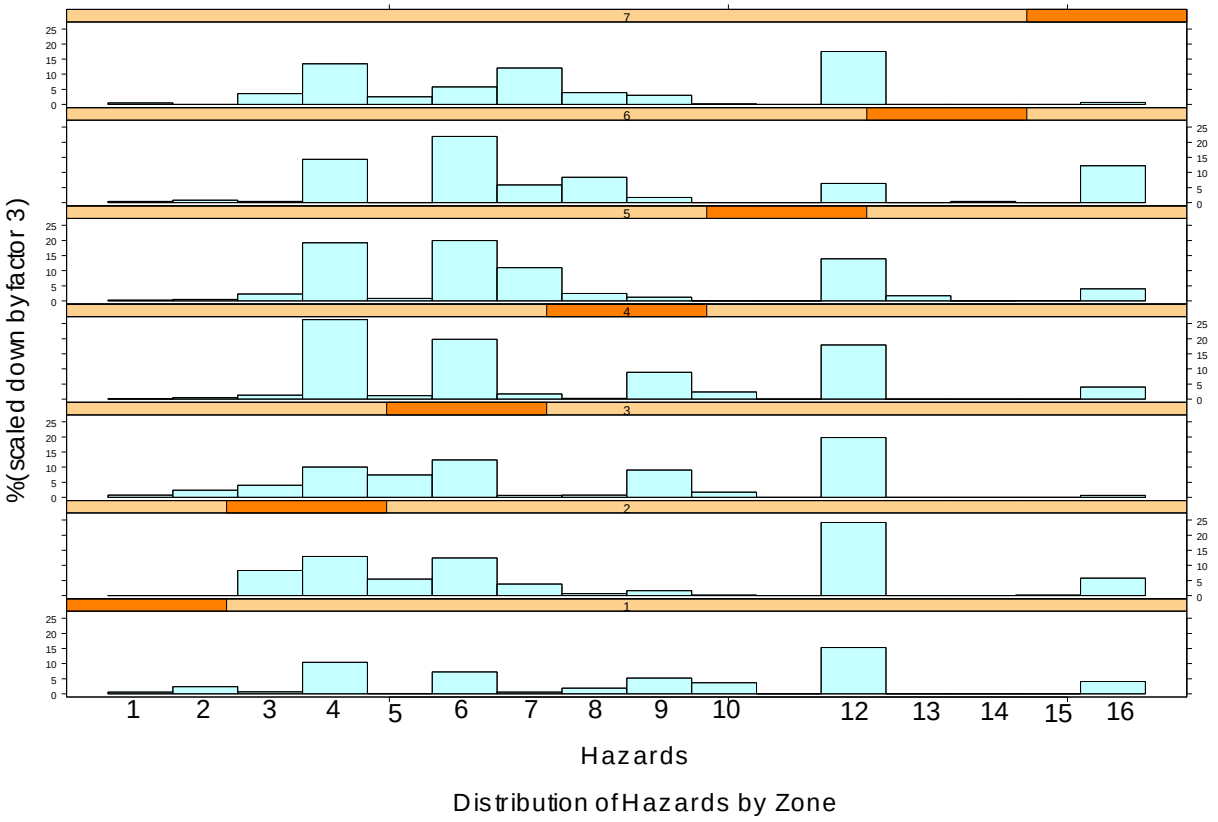

Figure 4 (a) Distribution of Hazards by Zone

Figure 3.5 shows the map of pest occurrence at national level. The result indicates that perception on occurrence of pests hazard is very high in zone 2 (The eastern plateau and mountain blocks), which account for 73% of the respondents. This zone encompasses part of Ruvuma, Morogoro, Dodoma Arusha, Manyara, Kilimanjaro, Tanga, Mtwara and Lindi regions. Followed by zone 3 (the Southern highlands), which accounts for 59%. This zone includes part of Ruvuma, Mbeya, Iringa, Dodoma, and Morogoro regions. Zones 4 and 7 which constitute (54% and 53%)respectively were classified as zones with medium level of pests occurrence, The zones covers the following regions, Arusha, Manyara, Kilimanjaro, part of Kigoma, Kagera, Rukwa, Mtwara, Morogoro and Iringa. Zone1, which is the Central plateau, indicated low pests

occurrence (45%), this zone consists of Dar es Salaam region part of Tanga, Morogoro, Mtwara, Lindi and Coastal region

Zone 5 which accounts for (42%) which include regions such as Mwanza, Shinyanga, Tabora, part of Dodoma, singida, Mbeya, Kigoma, Rukwa, Kagera, Mara Arusha also indicated low level of pest occurrence.

Zone 6 (the Rukwa- Ruaha rift zone) is the only zone, which indicated the least occurrence of pests hazard (19%), This zone consists of Rukwa region and part of Mbeya, Kigoma and Iringa regions.

Figure 3.6 shows drought occurrence map at the national level. This map indicates that there is a very high occurrence of drought in zone 4 (79%). This zone covers areas of Arusha region, part of Mara, Shinyanga, and Manyara regions. Followed by zone 5, (58%) which is classified as a zone with medium occurrence of drought. This zone consists of Shinyanga, Mwanza, Tabora, and Singida regions, part of Mbeya, Rukwa, Kigoma, Kagera, Mara, Dodoma, Iringa and Mbeya regions. Zones 2, 6 and 7 (39%, 43.%, 40%) respectively were classified as zones with low occurrence of drought hazard. These zones include Kagera, Manyara, Kilimanjaro, Part of Tanga, Morogoro, Iringa, Ruvuma, Mtwara, Rukwa, Kigoma and Kagera regions. Zones 1 and 3 indicated the lowest occurrence of drought hazard (31 % and 30 %) respectively. The zones include Dar es Salaam, Iringa, Morogoro, Mbeya, Ruvuma, and Mtwara and coast region.

Figure 3.7 shows a map of diseases outbreak occurrence at a national level. The results on the map show that zone 6 has the highest level of diseases occurrence, which accounts for (66%). The zone consists of Rukwa region and part of Mbeya, Kigoma and Iringa regions. Zones 5 and 4, which account for (60%, and 60%) respectively have been classified as zones with medium level of diseases outbreak. These zones covers the areas of Shinyanga, Mwanza, Tabora, and Singida, Mara, Arusha regions, part of Mbeya, Rukwa, Kigoma, Kagera, Mara, Dodoma, Iringa, Kilimanjaro, Manyara and Mbeya regions. Followed by zone 2 and 3 (38 % and 37 %), which have been classified as zones with low level of disease outbreak hazards. These zones comprise of Ruvuma region, part of Mtwara, Lindi, Ruvuma, Iringa, Dodoma, Coast, Manyara, Kilimanjaro, Tanga, Arusha and Mbeya regions. While Zone 1 and 7, which account for (22% and 17%) respectively indicated the least level of disease outbreak occurrence. These zones

cover most of the areas in Dar es Salaam, Tanga, Coast, Lindi and Mtwara, Kagera, Kigoma and Rukwa.

3.6.4 Health Hazards

The study revealed six major health hazards at household level. These are Malaria which was reported to be a problem in 85% of households, Dysentery (56%),Meningitis (4%), Cholera (4%) and Rabies (17%).

Figure 5 Pest occurrence at National Level

Figure 6 Drought occurrence at National Level

Figure 7 Disease outbreak occurrence at National Level

The major livestock diseases that were identified at the household level are Foot and Mouth disease, which was reported to be a problem by 26% of households, *Trypanosomiasis* (20%), Rabies (15%) and Anthrax (12%)

Table 3.10 shows the details of health hazards at national level based on data collected at household data, and the details of the same at rural and urban areas. Table 3-11 shows details of the occurrence of livestock hazards diseases at household level.

The same order of occurrence of health hazards is observed at village level. Malaria still ranks first where by 98% of sampled villages reported it to be a problem, followed by Dysentery (83%), Cholera (60%), Meningitis (54%), sleeping sickness (10%) and plague (5%).

For livestock diseases, Foot and Mouth is still on the top of the list. This disease was reported in 60% of villages followed by ndigana (59%), Rabies (49%) and Anthrax (31%). Table 3.12 and 3.13 show the details of health hazards at village level.

Table 3-10 Details of the Occurrence of Human Health Hazards (Household Level)

S/N	Disease Type	National estimate occurrence %	Rural occurrence %	Urban occurrence %
1	Cholera	24	27	20
2	Meningitis	24	28	18
3	Malaria	85	85	87
4	Dysentery	56	59	53
5	Plague	1	2	1
6	Sleeping Sickness	1	1	2
7	Rabies	17	21	12
8	Other diseases	17		20

Table 3-11 Details of the Occurrence of Livestock Health Hazards (Household Level)

S/N	Disease Type	National estimate occurrence %	Rural occurrence %	Urban occurrence %
1	Foot and mouth	26	30	20
2	Anthrax	12	14	10
3	Trypanosomiasis	20	23	15
4	Rabies	15	18	12
5	Other diseases	46	49	41

Table 3-12 Details of the Occurrence of Human Health Hazards (Village Level)

Disease	Rural (%)	Urban (%)
Cholera	57.14	65.63
Meningitis	53.06	56.25
Malaria	95.92	100.00
Dysentry	81.63	84.38
Plague	2.04	9.38
Sleeping Sickness	12.24	6.25
Rabies	44.90	31.25

Table 3-13 Details of the occurrence of Animal Health Hazards (Village Data)

Disease	Rural (%)	Urban (%)
Foot & Mouth	61.22	59.38
Anthrax	26.53	37.50
Ndigana	59.18	59.38
Rabies	51.02	46.88
Mdondo	65.31	78.13

At the district level four types of diseases Dysentery, Cholera, Meningitis and Malaria were all reported as leading diseases. However, Dysentery was the leading disease, which was, reported in 95% of the districts, followed by cholera, Malaria (93%). Others were Meningitis (85%), Rabies (76%), sleeping sickness (20%) and Plague (5%).

The leading livestock disease based on district data is *Ndigana* which 90% of districts mentioned it to be problematic, followed by Foot and Mouth disease (88%), Newcastle (87%), Rabies (85%) and lastly anthrax (46%). Table 3.14 and Table 3.15 show the health hazards using district data.

There is consistence in the reporting of the two top diseases of Malaria and Dysentry an at household, village and district level. However, level of reporting in percentage is different between the district and the lower levels. These differences may be partly explained by the reasons earlier advanced, but it is also possible that the district data show the number of people sick (for different diseases) who reported to the hospitals. Whereas the data at the household level indicate the number of people who actually were sick with a particular disease and this includes those who did not report to the hospitals.

Table 3-14 Details of the Occurrence of Human Health Hazards at District Level

Disease	**% of Districts**
Cholera	93
Meningitis	85
Malaria	93
Dysentry	95
Plague	5
Rabies	76
Sleeping sickness	20
Other epidemics	56

Table 3-15 Details of the Occurrence of Livestock Health Hazards (District Level)

Type of disease	% Districts
Foot and Mouth	88
Anthrax	46
Ndigana	90
Rabies	85
Newcastle	87
Other diseases	63

3.7 Timing of the Occurrence of the Hazards

The household survey indicated that most of the hazards occurred within a period of one year (2002-2003). The three most common hazards, which occurred within a period of one year, are Pests reported by 39% of respondents at household level, Drought (33%) and Disease outbreaks (27%). In the five past years the most common hazards were identified to be Drought (21%), Disease outbreaks (19%) and Pests and vermin (18%). Table 3.16 shows the details of timing of hazards occurrences at household.

To a large extent the timing of occurrence of hazards at village level is similar to that at household level. Many hazards, such as earthquake, drought, disease outbreak, fire and HIV/AIDS occurred within a period of one year. However, a number of hazards also occurred within a period of 1 to 5 years back. This includes HIV/AIDS, Fire and Floods. Table 3.17 shows the timing of occurrence of hazards at the village level.

Table 3-16 The Timing of the Occurrences of the Hazards (Household Level)

Hazard Type	Timing 5+ Years (%)	Timing 1-5 Years (%)	Timing 0- 1 Year (%)
1. Major accidents	2.86	3.71	1.85
2. Conflicts	1.15	3.21	2.56
3. Strong winds	5.86	14.69	8.42
4. Drought	6.32	21.40	33.23
5. Earthquakes	2.46	7.37	10.88
6. Disease outbreak	6.52	19.40	27.27
7. HIV/AID	5.26	5.56	19.30
8. Fire	4.66	7.22	8.92
9. Floods	6.32	11.98	7.02
10. Landslides	0.85	3.11	2.56
11 Technological hazards	0.00	0.00	0.00
12. Pests	5.51	17.59	38.75
13. Refugees	0.45	0.40	1.60
14. Volcanoes	0.00	0.10	0.00
15. Explosions	0.30	0.70	0.35
16. Others	1.35	3.16	7.67

Table 3-17 Timing of the Occurrences of the Hazards (Village Data)

	Hazard	Timing		
		5+ Years	1-5 Years	0-1 Years
4.	Drought	13%	21%	33%
6	Outbreak	7%	15%	45%
12	Pest	4%	15%	51%
3	Cyclone	32%	46%	22%
5	Earthquake	20%	24.14%	55.17%
7	HIV	13.73%	13.73%	72%
8	Fire	15.91%	18.18%	65.91%
9	Floods	42.11%	39.47%	18.42%

Data at the district level reveal that (just like at the village level) most of the hazards have been occurring for a period of less than five years. Hazards such as HIV, pests, disease outbreak and drought that are ranked high at the district level, they scored very high as occurring within the first year. Similarly, all high ranked hazards are also classified as commonly occurring. Table 3.18 gives the details of disaster timing and frequency using the district data.

Table 3-18 Timings and Frequency of Disaster Occurrences (District Data)

		Timing (%)			Frequency (%)		
	Hazard	5+ Years	1-5 Years	0-1 Years	Rare	Medium	Common
1	Major accidents	14	21	21	58	12	31
2	Conflicts	5	12	7	44	11	44
3	Strong winds	10	24	26	35	19	46
4	Drought	21	19	31	39	39	23
5	Earthquakes	7	7	26	44	17	39
6	Disease outbreak	12	29	48	16	19	65
7	HIV/AID	10	5	76			100
8	Fire	2	24	48	3	18	80
9	Floods	12	29	10	47	19	33
10	Landslides	17	5		63	25	13
11	Technological hazards	7	2		80	20	
12	Pests	5	17	57	3	15	82
13	Refugees	10		10	60		40
14	Volcanoes		2	2	33	33	33
15	Explosions	7	2	2	80		20
16	Others	7	10	19	24		76

3.8 Major Causes of Hazards

The general causes for hazards at a household level, can be classified as either natural and human factors or direct and indirect factors. Table 3.19 gives the details of the causes for major hazards. For example out of 937 respondents who reported drought to be a problem, 83% mentioned prolonged low rainfall to be the cause, followed by climatic change (60%) and human factors such as deforestation, poor farming methods and overgrazing (53%). Similarly, out of 995respondents who mentioned pests as a problematic hazard 37% of them mentioned climatic changes to be the cause, whereas followed by prolonged low rainfall/ dryness (31%),and poverty (14%). Out of 852 respondents who have been affected by Disease outbreaks 42% mentioned the prolonged heavy rainfall and dryness to be the cause, followed by health related factors (41%), climatic changes (30%) and poverty (10%). These causes can also be classified as being direct or indirect. Direct factors include deforestation, poor farming methods, overgrazing and lack of equipment and technology. The indirect factors can include poverty and climatic change.

Table 3-19 Causes for the Major Hazards (Household Level)

S/N	Hazard type	Causes	Percent
3.	Strong winds	Climatic change	57
		Deforestation, poor farming methods, overgrazing	48
		Prolonged low rainfall and dry spell	23
		Prolonged heavy rainfall and dryness	10
4.	Drought	Prolonged low rainfall and dry spell	83
		Climatic change	61
		Deforestation, poor farming methods, overgrazing	53
6.	Disease outbreak	Prolonged heavy rainfall and dryness	42
		Health related	42
		Climatic change	30
		Poverty	19
		Prolonged rainfall/ dryness	42
7	HIV/AID	Poverty	47
		Health related	16
		Administration, weak laws/by laws	10
9.	Floods	Prolonged heavy rainfall	83
		Deforestation, poor farming methods, overgrazing	20
		Climatic change	19
12.	Pests	Climatic changes	37
		Prolonged low rainfall/sunny weather	31
		Lack of equipment and technology	10
		Prolonged heavy rainfall/dryness	8
		Seasonal fruits/products	5

The major causes for hazards at the village are very similar as to those given at the household. Table 3.20 gives the details of the causes for each hazard.

Table 3-20 The Major Causes for Hazards (Village Level)

S/N	Hazard type	Causes	% of villages
3.	Strong Winds	Deforestation, poor farming methods, overgrazing	67
		Climatic change	67
4.	Drought	Prolonged low rainfall and dry spell	8
		Climatic change	10
		Deforestation, poor farming methods, overgrazing	10
6.	Disease outbreak	Prolonged heavy rainfall and dryness	40
		Health related	28
		Climatic change	16
		Poverty	25
7	HIV/AID	Health related	25
		Poverty	77
		Crowded gatherings	32
9.	Floods	Prolonged heavy rainfall	53
12.	Pests	Climatic change	27
		Prolonged low rainfall and dry spell	23
		Lack of expertise and technology	23
		Poverty	28

However, there is a difference in the perceptions as to which factor is the main contributor to a particular hazard. For example villagers believe that Strong winds are caused by deforestation, poor farming methods, overgrazing and climatic change. While the district authorities believe that other factors contributing to strong winds include prolonged low rainfall. Table 3.21 shows the causes of hazards at the district level.

Table 3-21 Causes for the Major Hazards (District Level)

S/N	Hazard type	Causes	% of Districts
	Strong Winds	Deforestation, poor farming methods, overgrazing	50
		Climatic change	33
		Prolonged low rainfall/dryness	33
3.			
	Drought	Prolonged low rainfall and dry spell	67
		Climatic change	67
		Deforestation, poor farming methods, overgrazing	87
4.			
	Disease outbreak	Prolonged heavy rainfall and dryness	42
		Health related	45
		Poor housing plan and drainage	50
		Poverty	70
		Lack of expertise and technology	33
6.		Prolonged heavy rainfall	42
	HIV/AID	Health related	25
		Poverty	79
7			
9.	Floods	Prolonged heavy rainfall	75
	Pests	Climatic change	45
		Prolonged low rainfall and dry spell	40
		Lack of expertise and technology	36
12.		Poverty	55

3.9 Impacts of the Hazards

Respondents at all levels were asked to state the impacts of the last disaster to the population and property. The main impact at the household level was identified to be loss of livelihood/income in which 48% of the respondents indicated as the case. This was followed by property damage (42%), illness or injury (35%), loss of life (28%), displacement (8%). While the disruptions of water and power, accounts for 5% only. See Table 3.22 for details.

Table 3-22 Impacts of Last Disaster on the Community

S/N	Type of impact	% Households
1	Illness/injury	35
2	Loss of life	28
3	Property damage	42
4	Loss of livelihood/income	48
5	Disruption of water/electricity	5
6	Displacement	8
	Others	11

At the village level detailed information in terms of morbidity and death was sought, the collected data revealed the following. Malaria caused the highest morbidity (66%), followed by AIDS (27%), Dysentry (6%) and cholera (7%). Similarly, Malaria was the number one killer at 33%, followed by AIDS at 19%. Other types of disease had low morbidity and death rates. Table 3.23 shows the morbidity and death rates for the diseases that were reported at the village level.

Table 3-23 Impacts of Last Disaster on the Community (Village Level)

Diseases	Morbidity			Deaths		
	Low (Below 50)	Medium (50-100)	High (100+)	Low (Below 10)	Medium (10-50)	High (50+)
Cholera	82.93	9.76	7.32	85	14.71	0
Meningitis	89.66	6.9	3.45	93	3.33	3.33
AIDS	62.5	10.42	27.08	53.19	27.66	19.15
Malaria	9.23	24.62	**66.15**	31.03	36.21	**32.76**
Dysentry	84.31	9.8	5.88	84.21	10.53	5.26
Plague	100	0	0	100	0	0
Rabies	96.55	0	3.45	100	0	0

Data from the district indicate that Malaria was still rated number one in affecting people. 81% of the district authorities reported that Malaria was number one disease in infecting people, followed by AIDS (62%) and Dysentry (41%) and Cholera 33%. Malaria also ranked number one as a killer disease by the districts. 65% indicated that it killed the highest number of people, followed by AIDS at 49% and Dysentry at 9%. Table 3.24 shows the impacts of health hazards on the community at the district level.

Table 3-24 Impacts of Last Disaster on the Community (District Data)

Diseases	Morbidity			Deaths		
	Low (Below 50)	Medium (50-100)	High (100+)	Low (Below 10)	Medium (10-50)	High (50+)
Cholera	42	12	33	66	23	
Meningitis	65	13	13	59	21	7
AIDS	18	15	62	14	32	49
Malaria	3	8	**81**	8	22	**65**
Dysentry	30	24	41	54	26	9
Plague						
Sleeping Sickness						
Rabies				80	3	

3.10 Hazard Manageability

A number of questions were asked to assess the level of hazard manageability at the household, village and district levels. The level of the details on manageability was different for all levels. At the household level the information sought was very basic such information was mainly on the hazards awareness. The information on manageability was much more comprehensive at the district level where details of organizational arrangement and organizations responsible for disaster management were studied.

The questions asked at the household level were meant to assess the level of disaster awareness and disaster information flow. Table 3.25 shows the details on manageability capacities. The results from Table 3.25 indicate that the level of disaster awareness at the household is still low. Even though 73% of the people listen to the radio, only 36% listen to *Jikinge na maafa* programme. The numbers of people who listen to the programme regularly is also low (14%). It is also found that the level of training on disaster management is only 16%.

Table 3-25 Disaster Awareness at the Household Level

S/N	Activity	Yes %	No %
1	Listening to the radio	73	27
2	Listening to *Jikinge na Maafa* programme	36	64
3	Regular Listening to *Jikinge na Maafa* programme	14	86
4	Disaster training	16	84

The households were also asked to indicate the media or mode from which they received information on the last disaster. Majority (32%) obtained information through public meetings Followed by Radio (31%), Newspapers (12%) and Posters (7%). Table 3.27 shows the details on the type of media used to get information on disaster..

Table 3-26 Media Used to Obtain Information on the Last Disaster

S/N	Type of media	Household %
1	Radio	31
2	TV	5
3	Newspaper	12
4	Meeting	32
5	Posters	7
6	Others	

At the village level four questions were asked to get an idea on disaster manageability. The questions were on the presence of disaster committees, rescue teams, rescue volunteers and availability of the first aid. The data revealed that the level of disaster management at the village level is still very low as only 28% of the villages indicated to have disaster management committees, 12% had volunteer rescue teams 12% had first aid facilities and 2% had rescue teams. However, the data showed a better situation on disaster awareness as 65% of villages sensitized people on disaster management issues within the past year. In addition 35% of villages were being reached by radio services.

More comprehensive information on disaster manageability was sought at the district level. Such information included organizational arrangement, institutions dealing with

disasters, level of emergency preparedness and information organization. On organizational arrangement, 83% of districts indicated to have disaster management committees, 25% had rescue teams, 38% had voluntary rescue teams, 41% had first Aid facilities, 20% had provisions for disaster management in their budget (See Table 3.28 for details).

Table 3-27 Organizational Arrangement at the District Level

Type of facility	% of district with the facility
Disaster committee	83
Rescue team	26
Voluntary rescue team	38
First Aid	41
Disaster budget	20

3.10.1 Critical Facilities and Disaster Budget

The question on the critical facilities was asked at the village and district level. Critical facilities in this context included all facilities that can be used in disaster management. At the village 63% of the villages indicated that they had playgrounds, 44% had dispensaries and clinics and 9% had hospitals. On the budget side only 1% of the villages had funds for disaster management. Table 3.28 shows the details of the availability of the critical facilities at the village level.

Table 3-28 Critical Facilities at the Village Level

Type of facility	Number of villages with at least 1 facility	% of village
Budget for disaster	1	1
Hospital	7	9
Dispensaries	36	44
Health centers	7	9
Clinics	36	44

Open Spaces	30	37
Playgrounds	52	63

The critical facilities at the district level include hospitals, dispensaries, clinics, health centers, fire brigades etc. These are expressed per 100,000 persons. Data show that only 20% of the districts have a disaster management budget. Table 3.29 shows mean number of the critical facilities at the district level.

Table 3-29 Critical Facilities at the District level

Type of facility	Number of Districts responded	Mean number per district per 100,000
Hospitals	40	1
Number of hospital beds	35	115
Number of ambulances	32	1
Number of radiography equipment	33	1
Number of dispensary	40	15
Number of health centers	39	2
Number of clinics	34	11
Number of doctors	38	3
Number of nurses	35	35
Number of fire brigade	18	1
Number theater	37	1
Number of mortuary	33	4
Number of fire fighting vehicles	16	0
Number of playing grounds	29	18
Number of opens spaces	27	7

3.10.2 Government and NGOs Participation in Disaster Management

At the district level a question was asked to determine the extent of government and NGOs participation in disaster management activities. The data shows that both government and the NGOs were involved in disaster management activities at different

degrees. Presently 86% of the districts are involved in campaigns against disasters. Table 3.30 shows both the extent of government and NGOs involvement in disaster activities at the district level. Government involvement in disaster management activities are as follows; 60% of the districts indicated that the government was involved in disaster prevention activities, 52% in disaster preparedness, 65% on disaster response and 54% on disaster recovery. The response on disaster involvement in disaster management activities for NGOs revealed the following. 61% of the districts acknowledged the involvement of the NGOs in disaster prevention, 68% on disaster prevention, 50% on disaster response and 68% on disaster recovery. From above information it can be concluded that government emphasis is focused more on response, while for the NGOs it is both on preparedness and recovery.

Table 3-30 Government and NGOs Participation in Disaster Management Activities

Activity	Govt. Participation (%)	NGOs participation (%)
Prevention	60	61
Preparedness	52	68
Response	65	50
Recovery	54	68

3.10.3 Emergency preparedness

The district authorities were also asked to provide information on disaster the extent of preparedness, indicating when they started and the extent of their activeness. The data reveal that all districts have emergency preparedness plans in terms of emergency plans, food emergency plan, land use plan, fire fighting plan, hospital emergency plans, disaster training, stock piling of supplies and disaster equipment. The response as to when these plans were in place in the districts was different for each district. The most resent plan is hospital emergency, which 48% of districts have adopted within two past years. Table 3.31 gives the details of emergency preparedness.

Table 3-31 Emergency Preparedness at the District Level

Type of the plan	Below 2 yrs	2-5 yrs	5-10 yrs
Emergency plan	10	10	9

Food emergency Plan	24	5	12
Land use plan	29	14	10
Fire fighting Plan	10	12	19
Hospital Emergency Plan	48	21	19
Disaster Training	21	26	17
Stock Piling of Supplies	26.09	14	14
Availability of disaster equipment	26	12	12

3.10.4 Disaster Information Management

The district authorities were required to indicate the method used in relaying the disaster information to them. The data shows that most of the information on disaster is conveyed to them by fax (80%). Other means include through messengers (55%), meetings (45%), information boards (38%), radio (37%), newspapers (24%), posters (24%), TV (20%) and through *sungusungu* 18%. Table 3.32 shows the details of information management at the district level.

Table 3-32 Information Management at the District Level

Communication means	District Responses (%)
Fax	80
Messengers	55
Meetings	45
Information boards	38
Radio	37
Newspapers	24
Posters	24
TV	20
Sungusungu	18
Others	36

3.11 Coping Strategies for Each Hazard

At household level the communities employ a variety of coping strategies for each hazard. Two main methods used to control pests are use of pesticides (38%), and guarding farms against destructive animals and pests (27%). For drought, the three main methods are selling of assets (33%), seeking employment elsewhere (29%) and growing drought resistant crops (22%). For disease outbreaks, the study showed that, two main coping strategies are attending hospitals (77%), and cleaning of environment and boiling of water (33%). Coping strategies for Flooding include migration (44%), construction of contours and trenches (30%) and construction of temporary shelters (16%). In the case of HIV/AIDS not much information was obtained to indicate the main coping strategies in place. Table 3.33 shows the details on coping strategies for each hazard.

Table 3-33 Coping Strategies for Each Hazard

S/N	Hazard type	Coping strategies	Estimates in %
	Strong Winds	Construction of contours and trenches	10
		Borrowing from friends, relatives, bank etc	9
		Selling assets	7
		Migration	7
3.			
	Drought	Selling assets	33
		Seek employment elsewhere	29
		Growing drought resistance crops	22
		Change of diet type	16
4.		Borrowing from friends, relatives, bank etc	15
	Earthquakes	Construction of temporary tents/camps	27
5.		Migration	6
	Disease outbreak	Going to hospital and counseling	77
		Cleaning environment and boiling water before drinking	33
6.			
	HIV/AID		
		Going to hospital and counseling	12
		Selling assets	4
7			
	Floods	Migration	44
		Construction of contours and trenches	30
9.			

		Construction of temporary tents/camps	16
12.	Pests	Using pesticides	39
		Guarding farms against destructive animals and pests	27

3.11.1 Generalizations of coping strategies at the zonal level

After determining the coping strategies for each hazard the next step was to establish the level of the coping strategies for the three most common hazards. The coping strategy in each zone was determined by combining the coping strategies at the household, village and district. This was achieved by taking into account the mostly used coping strategy at the household level combining with the coping strategies at the village and district level (based on the percentage of respondents at each level). Table 3.34 shows the manageability levels for drought in each zone. The coping strategies for drought range from 70% to 78%, with zone 2 having the highest values and zone 5 the lowest values of coping strategies.

Table 3-34 Generalized coping strategies for drought at the zonal level

	DROUGHT							
	Manageability	ZONE						
		1	2	3	4	5	6	7
household	Coping Strategy - Drought	43.86	50.62	37.63	73.27	43.11	29.41	30.38
village level	disaster committee	24.44	99.51	51.04	59.72	42.34	64.56	0
	Disaster Budget	0	0	0	0	0	0	0
	Sensitization	72.6	61.6	98.71	99.21	29.64	100	90.82
District level	Health centres	100	100	100	100	100	100	100
	Clinics	100	100	100	100	100	100	100
	Dispensaries	100	100	100	100	100	100	100
	Emergency Plan	100	100	100	100	100	100	100
	Hospitals	100	100	100	100	100	100	100
	Food Plan	100	100	100	100	100	100	100
	Disaster Equipment	100	100	100	100	100	100	100
	district disaster committee	100	100	100	50	75	100	75

	Disaster Budget	60	0	0	16.67	16.67	0	25
	Drought	76.99	77.82	75.95	76.83	69.75	76.45	70.86

Table 3.35 shows the coping strategies at the zonal level for disease outbreak. Zone one has the highest level of coping strategies at 71% while zone seven has the lowest coping strategies at 62%. Similarly, Table 3.36 shows the coping strategies at the zonal level for pests. Zone six has the highest level of coping strategies at 74% while zone five has the lowest coping strategies at 57%.

Table 3-35 Generalized coping strategies for disease outbreak at the zonal level

	OUTBREAK							
	Manageability	ZONE						
		1	2	3	4	5	6	7
household	Coping Strategy - Outbreak	52.5	60.26	82.61	75.33	86.67	65.38	52.94
village level	disaster committee	24.44	99.51	51.04	59.72	42.34	64.56	0
	First aid team	23.4	14.15	0.62	1.89	24.92	0	2.38
	Disaster Budget	0	0	0	0	0	0	0
	Sensitization	72.6	61.6	98.71	99.21	29.64	100	90.82
District level	Health centres	100	100	100	100	100	100	100
	Clinics	100	100	100	100	100	100	100
	Dispensaries	100	100	100	100	100	100	100
	Emergency Plan	100	100	100	100	100	100	100
	Hospitals	100	100	100	100	100	100	100
	Disaster Equipment	100	100	100	100	100	100	100
	district disaster committee	100	100	100	50	75	100	75
	First aid team	66.67	40	33.33	16.67	36.36	100	25
	Disaster Budget	60	0	0	16.67	16.67	0	25
	Outbreak	71.40	69.68	69.02	65.67	65.11	73.56	62.22

Table 3-36 Generalized coping strategies for pests outbreak at the zonal level

	PEST							
	Manageability	ZONE						
		1	2	3	4	5	6	7
household	Coping Strategy- Pest	64.02	35.1	41.76	52.17	51.65	73.33	27.18
village level	disaster committee	24.44	99.51	51.04	59.72	42.34	64.56	0
	Disaster Budget	0	0	0	0	0	0	0
	Sensitization	72.6	61.6	98.71	99.21	29.64	100	90.82
District	Emergency Plan	100	100	100	100	100	100	100
	Food Plan	100	100	100	100	100	100	100
	Disaster Equipment	100	100	100	100	100	100	100
	district disaster committee	100	100	100	50	75	100	75

	Disaster Budget	60	0	0	16.67	16.67	0	25
	Pest	69.00	66.24	65.72	64.19	57.25	70.87	57.55

CHAPTER FOUR

4. Development of National Vulnerability Index

This chapter focuses on the development vulnerability index. In developing the vulnerability index three main components were considered hazards, risk and manageability or coping strategies. The calculation of the index is based on the mathematical expression for calculating the index is already discussed in Chapter One. The household data used to determine the hazard and risk values due to the fact that it reflects more on the perceptions of the communities as to which are the main hazards and also the risk model fits better in a larger data set. The value for each hazard was taken as being equal to the response value in percentage. While, The assessment of risk was estimated using probabilities of negative effect to happen to an individual. However, in determining the values of coping strategies for each zone, manageability capabilities from all three levels were taken into account. This is due to the fact that the manageability aspects at the three levels are all different but at the same time supporting each other. Therefore combining the coping strategies at the household, village and district give a more reliable picture of the manageability capacities at the district level. Combining responses of coping strategies for each hazard therefore derives the values of manageability for each district.

4.1 Risk Assessment

Three response variables at household level were used in assessing risks. These were the effects of the last reported disaster with respect to

1. Loss of life
2. Loss of property, and
3. Loss of income.

All three variables were binary in nature.

Moreover it was believed that, the occurrences of loss of life, income, and property to an individual is associated by some of the factors identified mostly at household and village level. Even though there was a substantial number of hazards reported to have been occurred in different communities, only a handful of them could lead to loss of life and these may differ in their strength and importance of their effects.

The above-mentioned reasons formed a basis for statistical models used in assessing the risk associate with the hazard effects. The goal was to find the best fitting and most parsimonious, yet socially reasonable model to describe the relationship between an outcome (response variable) and a set of explanatory (predictor) variables.

A good-fitting model has several benefits: -

1. Inferences for model parameters help in determination of explanatory variables, which affect the response, while controlling for the effects of possible confounding variables.

2. Estimation of parameters is more informative than mere significance testing, that is, the size of estimated model parameters determine the strength and importance of the effects

3. Model based predicted values can be obtained.

4. Complicated situations can be handled e.g. analyzing simultaneously the effects of several explanatory variables.

In situations such as the one at hand, that is, with variables, which are discrete, a logical choice of models to be fitted belongs to a class of *Generalized Linear Models* (GLM). In this particular context, *logit* models are preferred due to the nature of response variables.

4.1.1 Model Selection

In this process the variables/factors thought to influence the outcome of disaster were added and removed in a sequential manner until a model that describes the data reasonably well was obtained.

Among possible approaches for model selection, the stepwise selection method was employed due to the advantage that, it combines other approaches, that it is, backward elimination and forward selection methods.

In the model building phase, variables which met the criterion by Hosmer and Lemeshow, (i.e. with p-value of at least 0.25 in a univariate logistic regression analysis) were considered.

Tables 4.1, 4.2, 4.3 and 4.4 show the summary of the final selected models, the intermediate results have been omitted.

Table 4.1 Hazards and Other Factors Associated with Loss of Life

Parameter	DF	Estimate	Standard Error	Chi-Square	Wald Pr > ChiSq	
Intercept	1	-32,081	0.3536	823,064	<.0001	
posters	1	0.6578	0.2648	61,705	0.0130	
disease outbreaks	1	0.6395	0.2468	67,114	0.0096	
HIV/AIDS	1	13,918	0.4286	105,430	0.0012	
disaster committees	1	0.8238	0.1628	256,149	<.0001	
sensitization	1	0.6132	0.2136	82,396	0.0041	
zone 1	1	-0.3347	0.6945	0.2322	0.6299	**
zone 2	1	0.0162	0.3218	0.0025	0.9597	**
zone 3	1	0.3683	0.2602	20,047	0.1568	**
zone 4	1	-13,701	0.3721	135,587	0.0002	
zone 5	1	0.7820	0.2634	88,114	0.0030	
zone 6	1	10,828	0.3056	125,564	0.0004	
disabled	1	0.2230	0.1047	45,345	0.0332	
distance from dispensary	1	0.2445	0.0605	163,162	<.0001	

**Factors that are not significant to the loss of life (at 5% level of significance)

For the loss of life (Table 4.1), the hazards that were found to have a significant impact were Disease Outbreaks and HIV/AIDS. Other contributing factors were, the number of disabled in the households and distance (in km) from the household to the nearest dispensary. Figure 4.1 shows the relationship between the loss of life and the distance (in km) from the household to the nearest dispensary

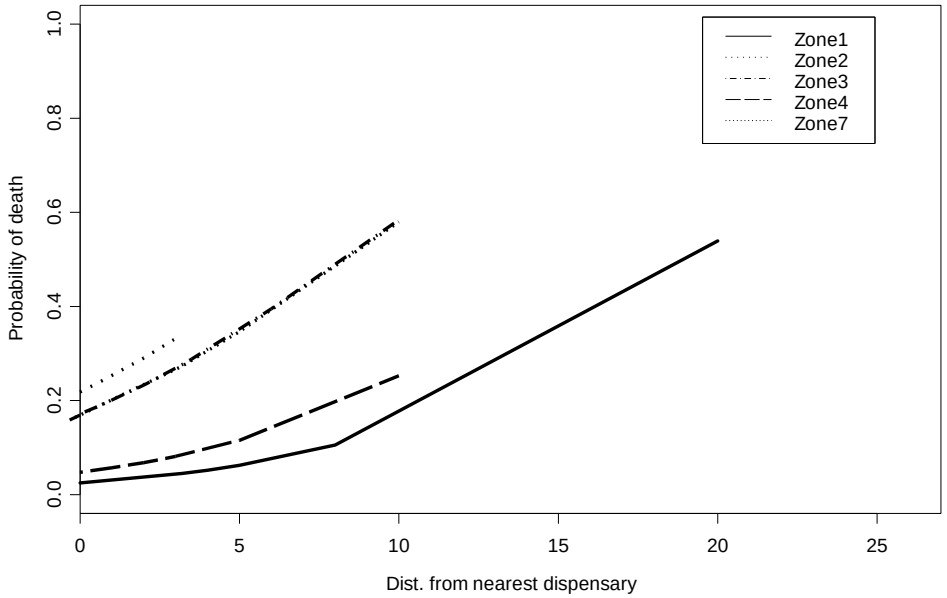

Figure 4-1 Association between Distance from Nearest Dispensary Versus Probability of Death

The model also revealed that, unlike in other zones, people living in zones 5 and 6 have a much higher risk to the loss of life when hazards occur.

Table 4.2 Hazards and other Factors Associated with the Loss of Property

Parameter	DF	Estimate	Standard Error	Chi-Square	Wald Pr > ChiSq
Intercept	1	-0.0643	0.2443	0.0693	0.7923
Conflicts	1	15,382	0.5203	87,404	0.0031
disease outbreaks	1	0.4259	0.1775	57,586	0.0164
floods	1	10,966	0.2500	192,453	<.0001
disaster committees	1	0.5348	0.0990	291,834	<.0001
resque teams	1	11,315	0.1812	389,846	<.0001
sensitization	1	-0.3055	0.1061	82,856	0.0040
Illiteracy	1	0.1316	0.0342	148,346	0.0001

Note: Zone is not associated with the loss of properties,thus it is excluded in the model

In the case of loss of properties, Conflicts, Disease Outbreaks and Floods contributed significantly to this effect. Other factors included the level of illiteracy at household as well as the level of sensitization at village level. This effect doesn't seem to differ among zones.

In the case of loss of income, the hazards, which are significant, were to be drought and floods. Again as was the case with loss of property, the zone effect doesn't seem to be significant with loss of income.

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr> ChiSq
Intercept	1	0.6437	0.2653	58,867	0.0153
drought	1	0.8683	0.1710	257,785	<.0001
floods	1	0.7791	0.2557	92,815	0.0023
resque team	1	10,138	0.2398	178,798	<.0001
fire fighting vehicles	1	0.0172	0.00553	96,343	0.0019

Note: Zone is not associated with the loss of income

Table 4.3 Hazards and Other Factors Associated with the Loss of Income

From the three constructed models, one can see that, the higher the proportion of hazard effects, the higher was the level of manageability. This may reflect the fact that, most communities mainly focus on mitigation measures rather than prevention in fighting against hazards.

i) Risks to hazard effects

Using the fitted models obtained in table 4-1 to table 4.3, hazard risks for a particular effect i.e. loss of life, loss of property and loss of income were estimated for each individual in the study. Individuals from the same zone were grouped and they estimated risks averaged to derive the zonal risks per effect.

These were then pooled together to obtain a single estimate. In the pooling process, the loss of life was given the highest weight (0.7) whereas loss of properties and loss of income were given equal weights (0.15) Table 4.5 summarizes these findings. Risk being a probability ranges from 0 to 1, with 0 being an ideal desirable situation while 1 is the worst scenario. It is also important to note that even though pests as an hazard ranks very high, its effects based of result results are not significant.

Based on Table 4.4, zone six, which is the Rukwa-Ruaha area has the highest risk has the highest risk at 0.53. This means that in case of an occurrence of a hazard the possibility of loss of life, property or income is highest in this zone. In this zone loss of life has the highest mean value and probably contributed by death due to high level of disease outbreak. The second risk area is zone 5 that is the central plateau area has a value of 0.42. In this zone the probability of loss of income has the highest value at 0.64 this is probably due to drought occurrences. Zone three, which is the southern highlands is ranked third at 0.3.8. The coastal zone has the lowest risk at 0.16. This means that in case of hazard occurrence the loss of life, income or property will be lowest in the coastal zone compared to other zones.

Table 4.4 Rankings of Zones in Accordance to Hazard Risk

Zone	Mean Probabilities			Pooled Probabilities	Ranking
	Loss of Income	Loss of Property	Loss of Life		
1	0.56	0.34	0.03	0.16	7
2	0.55	0.50	0.22	0.31	4.5
3	0.57	0.45	0.32	0.38	3
4	0.75	0.60	0.16	0.31	4.5
5	0.64	0.41	0.38	0.42	2
6	0.50	0.40	0.57	0.53	1
7	0.48	0.24	0.06	0.15	6

4.2 The Vulnerability Index

Vulnerability index was determined three hazards only of drought, disease outbreaks and pests due to a number of reasons including time limitations. The values for hazards, and manageability as determined in chapter Three, and risk values at the zonal levels were all combined to form Table 4-5. The top most row shows the seven agro-ecological zones, the second row shows the manageability of the three hazards in each zone, the third row indicates the values of three hazards for each zone. The fourth row shows the pooled risks for each zone and the last row is the vulnerability index for the three hazards in each zone. The vulnerability index was calculated by using the values in Table 4-5 and vulnerably formula as indicated in Chapter One. For example the vulnerability index of for drought in zone (coastal areas) one 0.06, was calculated by multiplying drought value of 31.06 by risk value of 0.16 and dividing by manageability factor of 76.78. Overall, the results show that vulnerability index for drought is highest in central plateau and lowest in the coastal zone, for disease outbreak, it is highest in zone 6 (Rukwa-Ruaha) and lowest in zone 7 (Inland sedimentary plateau, Ufipa plateau and western highlands) ,for pests it is highest in zone two and lowest in zone one. The detailed explanation for the index for each hazard is as follows.

Table 4.5 Vulnerability Index Parameters by Zone

		Zone						
		1	**2**	**3**	**4**	**5**	**6**	**7**
Manageability on three major hazards	Drought	76,78	76,47	75,89	74,72	68,57	76,60	71,02
	Outbreak	71,56	69,62	68,75	65,09	64,74	74,06	62,24
	Pest	69,75	66,19	66,68	64,05	57,07	73,84	57,95
Hazards	Drought	31,06	38,94	30,00	78,91	57,69	43,04	40,21
	Outbreak	21,80	37,50	37,10	59,83	59,59	65,82	17,35
	Pest	44,69	72,60	58,71	53,91	41,80	18,99	52,55
Risk		0,16	0,31	0,38	0,31	0,42	0,53	0,15
Vulnerability Index	**Drought**	**0,06**	**0,16**	**0,15**	**0,33**	**0,35**	**0,30**	**0,08**
	Outbreak	**0,05**	**0,17**	**0,21**	**0,28**	**0,39**	**0,47**	**0,04**
	Pest	**0,10**	**0,34**	**0,33**	**0,26**	**0,31**	**0,14**	**0,14**
	General	**0,07**	**0,22**	**0,23**	**0,29**	**0,35**	**0,30**	**0,09**

4.3 Discussion of the Vulnerability index results

Pest vulnerability

The discussion of the results is confined to the three most common hazards of pests, drought and disease outbreak.

The vulnerability index for the pests hazard show that parts of southern highlands and eastern plateau and mountain blocks are the most vulnerable agro-ecological zones at 0.34. This includes parts of Ruvuma, Morogoro, Dodoma, Manyara, Tanga and Kilimanajaro, Matwara and Lindi Regions. Figure 4.1 shows vulnerability assessment for the pests per zone.

These regions are highly vulnerable to pests due to the fact that the communities in these areas, firstly, are very much engaged in farming activities. As a result of this many different types of crop pests can also be found in these areas. Second, some of these areas are adjacent to conservation areas or natural vegetation with a lot of wild animals or vermin. The wildlife are a menace to the local population by either destroying their crops or even killing or injuring them as in the case with lions in Tunduru area.

Considering the level of manageability to this zone, it has been observed that most of the districts have the disaster emergency plans, food plans and disaster management committees however, there are no disaster budgets set aside in case of any disaster. Moreover, the study revealed that there is a relatively low level of sensitization at the household level as regards to pest hazard (see table 4.1).

Although, comparing to other agro ecological areas, zone two has relatively high manageability capacities 65, however the combination of high presence of crop pests (high risk at 31) and vermin makes the presence of pests very high 72 and thus causing the area to be highly vulnerable to the pests.

The second most vulnerable areas are parts of the southern highlands and the inland sedimentary plateau. This includes parts of Iringa, Morogoro, Songea, Lindi, Mtwara and Dodoma regions. The reasons as to why they are vulnerable are the same as for zone three except that the manageability capacity is slightly higher at 580% (see table 4.1). This zone has got very low coping strategy at the household level (20%), no disaster committee at the district level, but has higher level of sensitization at 90% at village level.

The third most vulnerable area is zone 3 that is the Central plateau covering parts of Dodoma, Iringa, Sumbawanga, Kigoma, Mara, and Manyara. This zone also includes

the whole Regions of Singida, Tabora, Shinyanga and Mwanza. These regions even though they have low manageability capacities (compared to zone 2 and 3) are relatively less vulnerable due to the fact that the occurrences of pests in these areas are relatively low compared to zone three and two (see figure 4.1). This zone has got relative better coping strategies at the household level (45%), village in this zone have got disaster committees and sensitization at 62%.

Coastal zone (zone one) is the least vulnerable area because it has low occurrences of pests probably due to less agricultural activities and less wildlife compared to other areas. However, it has relatively high capabilities in pest management compared to zones such as the central plateau as zone one has disaster budget, food plans, emergency plans and district disaster management committees for pest hazard, In the coastal zone the coping strategies at the household level are high (65%), 24% of the villages have disaster committees and the sensitization level is at 73%. In addition some of the districts have disaster budgets.

Vulnerability to drought

According to the vulnerability index the central plateau zone is the most vulnerable (0.35), closely followed by Northern rift zone and volcanic highlands (0.33) and Rukwa-Ruaha Rift zone. Coastal zone has relatively high coping strategies at the household level (35%). At the district level it has relatively high sensitization level (75%) and districts have disaster budgets. The other four zones of Eastern plateau and mountain blocks (0.16) Southern highlands (0.15), Coastal zone, (0.8) and Western highlands and Ufipa Plateau are relatively less vulnerable to drought. Central plateau even though has lower drought occurrences compared to zone 4; it has a highest vulnerability due to the fact that it has the second highest risk factor after zone six which indicates low drought manageability capacity. The regions in this zone have already been mentioned. Even though drought occurrences is highest in zone 4 at 78, its vulnerability is second highest because this zone has relatively low risk factor (31) compared to zone 5 which implies higher drought manageability capacities. Zone 6, which is the third most vulnerable area, even though it has the highest risk factor, compared to other zones, but it has relatively low drought occurrences and the highest manageability capacities. Thus making it third most vulnerable zone. The other zones have low drought vulnerability essentially because they have low drought occurrences and high manageability

capacities. Figure 4.2 shows the drought vulnerability in Tanzania. Moreover, these zones receive relatively high rainfall per annum between 1000-1400 mm where as the zones, which are vulnerable to drought, receive low rainfall of 600mm and even below (NEMC 1990).

Vulnerability to disease outbreak

The most vulnerable zone for disease outbreak is the Rukwa-Ruaha rift zone, which is zone 6. It covers small parts of Kigoma, Rukwa, Mbeya and Iringa Regions. The communities in this zone are most vulnerable to diseases because it has the highest rates of occurrences of the major diseases such as meningitis (43%), AIDS (60%), Malaria (99%), Dysentry (68%) and Rabies (48%). Consequently, the overall occurrence of the diseases is the highest at (66%) and as a result of this it has the largest risk factor of 0.53. In spite of the fact that zone 6, has the highest manageability capability at 74 however, the findings indicate that it has neither first aid nor disaster budget at the household level and it has no any budget set aside for any disaster at the district level.

The second most vulnerable area is the Central plateau (0.39) because it has the second highest disease occurrence at 60 and a risk factor of 0.42 after zone 6. The most common diseases are cholera (44%), Meningitis (45%), AIDS (57%), Malaria (84%), Dysentry (64%) and Rabies (34%). The zone also has a low level of diseases manageability capacities compared to all other zones except zone 7. The third most vulnerable area is zone 4. The disease occurrences are the same as in zone 5 but it has a low risk factor of 0.31 and higher manageability capacity (65) than zone 5.

Zone 1 is least vulnerable to disease outbreak (0.05) compared to the rest of the zones. As for the case of manageability Zone 1 has relatively higher manageability level of 71% and also the risk to different hazards is relatively low at 0.16. The high level of manageability coupled with low risk level might suggest the finding that zone 1 is less affected by disease outbreak. Figure 4.3 shows the details of disease vulnerability assessment.

CHAPTER FIVE

5 Conclusion and recommendations

5.1 Conclusion

Tanzania is one of the countries prone to disasters and has a long history of them. The vulnerability assessment has been carried out in order for the country to develop policies, programmes and projects for mitigating disasters.

The overall research strategy can be categorized into three main phases, pre-field work, fieldwork and post-field work. Activities conducted in the pre-field work phase included, literature review, preparation of the survey instruments, identification of the key informants, selection, training of the data collectors and researchers protocol development and pre-testing of research tools. Fieldwork phase involved collection of data at the household, village and district level. Post-field work involved data coding, entry and cleaning and analysis.

The sample size used for the household survey was 2040 and was expected to yield statistically reliable estimates of population at the National level. The sample size for the village survey was 84 and included villages both in urban and rural settings. The sample size for districts was 42 and included both non hazard prone and prone districts.

Among other factors Agro-ecological zones were considered selecting districts to be sampled, so that it could be possible extrapolate the results within each zone.
Data analysis was carried out at household, village and district levels. Due to the fact that the household data was large enough to make reliable estimates, all national estimates, except for the generalized coping strategies, have been made using the household data.

The analysis of this report shows a number of aspects, including the socio-economic conditions, occurrence of the hazards and their causes, impacts, coping strategies, disaster risk levels and vulnerability index.

Household and village data in many cases seems to be similar compared to district data. One possible explanation is that household and village data are based on the perceptions of the communities, while most of the district data is from records.
The main economic activity is agriculture, followed by livestock keeping, trade, formal employment and fishing. The findings from the study indicate no significance difference in social-economic activities between rural and urban settings. One possible explanation is that the dominant rural population has masked the characteristics of urban dwellers. Another possible explanation is that large rural areas adjacent to urban areas are administratively classified as urban areas.

On socio economic services, 65% households still depend on traditional sources of water such as wells, rivers, lakes and water harvesting for their daily water needs. It is only 35% who are connected to piped water supply services.

The five common socio-economic infrastructures at the village level are Schools followed by public buildings wells bridges and dams.

The five main hazards perceived by the communities, using household data are pests, drought, disease, HID/AIDS and floods. Most of the disasters at the household level were reported to have occurred within one year.

On the health hazards malaria, Dysentry, HIV/AIDS are the most serious problems both in terms of morbidity and death rates

The major causes of disasters can be classified as both anthropological and natural. Anthropological include poor farming practices, weak administrative system and laws. While the natural causes include, climatic change and tectonic activities.

The main impacts are illness and injury, loss of life, property damage and loss of livelihood.

There are different levels of manageability of disasters from the household level to the district. At the household level 36% of the people are listening to the *Jikinge na Maafa* programme. At the village level about 83% of the villages have disaster

committees. At the district level a number of government and NGOs are involved in disaster management activities at different degrees.

All districts have some sort of critical facilities, such as hospitals, open spaces, ambulances and various types of manpower that can be used during a disaster.
In order to assess the level of vulnerability for different hazard, a vulnerability index was developed. The index had three main components, the hazard, risk factor and manageability. Vulnerability was carried out for the three most common occurring hazards of pests, drought and disease outbreak. The results indicate that areas that are most vulnerable to pests are either engaged in crop production or are near conservation areas with a lot of wildlife. Areas most vulnerable to drought are those with normally have low rainfall and poor coping strategies. At the same time the areas most vulnerable to disease have a high occurrence of diseases and poor coping strategies.

The research findings also revealed that, enriching the districts with manageability capacities by itself does not necessarily mean that the levels of disasters at village and household levels will also be reduced. The levels of communication between the district and grassroots levels need to be strengthened. This should go parallel with the improvement on infrastructure

Comparison between VA1 and VII in terms of overall research strategy, sample size, data analysis and outcome shows a significance difference between the two studies. The overall strategy of VAI was to collect data from the districts and wards. In VAII data was collected from three levels of household, village and district. In VAI 57 districts and 171 wards were sampled, in VAII it was 42 districts, 84 villages and 2040 households. In VAI data collection was done at the regional, district and ward levels. In VAII no data was collected at the regional level. In VAI a similar questionnaire was use to get data from all the three levels. While in VAII each level of data source had its own tool.

Data analysis in VAI was done less systematically in terms of types of hazards, causes, impacts, coping strategies risk and vulnerability index. In VAII data analysis was much more systematic done and it clearly differentiated the perceptions on

disaster management for the three levels. In addition VAI did not have maps and vulnerability index was not properly executed. VAII report is supported by a number of maps and vulnerability index was clearly and systematically done.

However, despite all the differences, the top five hazards that is pests, drought, disease outbreak, floods and strong winds identified in both studies are more or less similar.

It is important to point out that this study has been carried out in a drought year. Therefore the timing of the study might have influenced the perceptions as to what are the main hazards, with more respondents pointing out drought as one of the main hazards. This can be cited as one of the limitations of this study.

5.2 Recommendations

VAII report should be considered as the most update and comprehensive vulnerability assessment report to be used by all stakeholders interested in disaster management in Tanzania. VAI can be used as a background document to supplement whatever is not included in VAII.

Since this document systematically identifies basic elements in disaster management as perceived by communities from the household level to the district level. The government and other stakeholders can easily use the findings of this research to develop intervention measures at different levels.

The government and other stakeholders should initially focus it attention in developing coping strategies in regions that are most vulnerable to the common five disasters. This report can be used to identify the weak coping strategies that need to be improved in concerned regions.

UCLAS and DMD and other interested parties should make further analysis of the existing data so as to make full use of the already collected data in improving disaster management in Tanzania.

UCLAS and DMD and other interested parties should compare the vulnerability results with other parameters, such as rainfall distribution, poverty levels, farming systems, disease occurrences and other to see if there is a correlation.

The government and other stakeholders should try to establish the reasons for the difference in data between the districts and the household and village level. This can ultimately lead to improvement of data and disaster management the district level.

6 References

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7 GLOSSARY OF TERMS

- **Conflict:** Disagreement of two groups which cause social and economic disruption in a community Examples are war, insurgency such as from radical or political groups or civil unrest such as student or mob activity, which can disrupt normal life of a community;
- **Disaster:** A serious disruption of the functioning of a society, causing a widespread human, material and environmental losses which exceed the ability of the affected community to cope with from its own resources.

  Disaster is sometimes also used to describe a catastrophic situation in which the normal patterns of life (or eco-systems) have been disrupted and extraordinary, emergency interventions are required to save and preserve human lives and/or the environment.
- **Drought:** A lack of adequate water for crops, livestock and communities due to prolonged low rainfall. It is often caused by climatic change;
- **Earthquake:** A well known movement, slippage of crystal rock, deep within the earth causing the surface to move very violently and so causes damage to infrastructure and in so doing causes death;
- **Explosion:** A violent man-made event such as a bomb blast or liquid petroleum gas;
- **Fire:** Uncontrollable burning of urban settlements or forests or aeroplanes that destroys life and property;
- **Flood:** Significant rise of water level in a stream, lake, ocean etc that destroys life and property. Floods often build up slowly and are usually seasonal. They cause physical damage by washing away structures, crops and animals. Casualties and deaths may occur from drowning. Floods are followed by an outbreak of malaria, diarrhoea and viral infections. The floods also contaminate wells and ground water. As a result of this clean water becomes scarce, unavailable and a possible outbreak of cholera;
- **Landslides:** A landslide is a down slope transport of soil and rock resulting from naturally occurring vibrations, changes of water content or removal of lateral support. Landslides are very difficult to predict but their frequency and extent can be estimated by use of information on the area geology, geomorphology, hydrology, climate and vegetation;
- **Major accidents:** Man-made transport type of disaster comprising of air, marine,

road, and rail crash which suddenly destroys life, property and quite often the environment;

- **Mitigation:** Encompasses all activities undertaken in anticipation of the occurrence of a potentially disastrous event, including preparedness and long-term risk reduction measures. The process of planning and implementing measures to reduce the risks associated with known natural and manmade hazards and to deal with disasters, which do occur. Strategies and specific measures are designed on the basis of risk assessments and political decisions concerning the levels of risk, which are considered to be acceptable, and the resources to be allocated (by the national and sub-national authorities and external donors). Mitigation has been used by some institutions/authors in a narrower sense, excluding preparedness. It has occasionally been defined to include post disaster response, then being equivalent to disaster management, as defined in this glossary. Measures, which reduce the impact of a disaster phenomenon by improving a community's ability to absorb the impact with minimum damage or disruptive effect. The measures include both preparedness (see above) and protection of physical infrastructure and economic assets. In practice mitigation involves actions such as:
    - Promoting sound land use planning based on known hazards;
    - Relocating or elevating structures out of flood plains;
    - Developing, adopting, and enforcing effective building codes and standards;
    - Engineering roads and bridges to withstand earthquakes;
- **Pest infestations:** Increase in pest numbers. Pest infestations are a major problem in tropical climate both during the growing and post harvest seasons. Pest numbers increase due to one or a combination of ecological factors including temperature, monoculture of crops, introduction of new pest species, overcoming genetic resistance in host, overcoming pesticide effects, conducive weather patterns, and migration. This leads to the damage of plants and harvested crops, consequently leading to food shortages, famine and economic stress;
- **Preparedness:** Measures taken to enhance the abilities of individuals, communities and businesses to respond to a disaster. These involves the development and regular testing of warning systems (linked to forecasting

systems) and plans for evacuation or other measures to be taken during a disaster alert period to minimise potential loss of life and physical damage; the education and training of officials and the population at risk; the establishment of policies, standards, organisational arrangements and operational plans to be applied following a disaster impact; the securing of resources (possibly including the stockpiling of supplies and the earmarking of funds); and the training of intervention teams. Enabling legislation must support preparedness.

- **Preparedness activities:** are sets of activities, which enhance the abilities of individuals, communities, and businesses to respond to a disaster. Disaster exercises, disaster-preparedness training, and public education are examples of preparedness activities;
- **Prevention:** means those measures which are aimed at stopping a disaster from occurring and/or preventing such occurrence having harmful effects on communities (or groups of individuals) such as vaccination programmes by the health sector;
- **Recovery:** This phase will encompass those activities necessary to provide a rapid return to normality both for the community and for those involved with the response.
- **Refugee:** Any person who owing to a well founded fear of persecution for reasons of race, nationality, religion, member of a particular social group or political opinion is outside his or her country, who is unable, owing to such fear, to avail himself or herself the protection of that country - someone who crossed an international frontier and is entitled to protection as a refugee under the UN protocol (1967).
- **Response:** All activities taken during or right after hazard/disaster occurred to reduce the loss and address the immediate and short-term effects of an emergency or disaster. Response includes immediate actions to save lives, protect property, and meet basic human needs. Based on the requirements of the situation, response assistance will be provided to an affected area under the National Response Plan using a partial activation of selected primary agencies or the full activation of all the primary agencies to meet the needs of the situation. Response activities, during the immediate aftermath of a disaster, deal with emergency needs and restore community services. For example, Red Cross mass care, spontaneous and professional search and rescue, damage

assessment, and provision of communications are ways that people and organisations respond;

- **Technological disaster:** There are a variety of installations in the country where disasters such as fire, explosions, toxic releases are possible. As a result of increasing industrialisation, incidence of these kinds of disasters are expected to increase. Transport based disasters such as aeroplane crash, ship wreck, train collisions, etc have been experienced, and form part of technological disasters;
- **Vulnerability assessment** is the process of estimating the vulnerability to potential disaster hazards of specified elements at risk.

Vulnerable Groups: Categories of disaster affected persons, or displaced persons, with special needs, invariably defined to include: unaccompanied minors, the elderly, the mentally and physically disabled, victims of physical abuse or violence and pregnant, lactating or single women.