Federal Foreign Office

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Humanitarian Aid and Civil Protection

Training Package on Natural Hazards and Early Warning for Training of Trainers' in Kenya

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The training package looks forward for greater improvement from the inputs and feedback to be received from the participants during the planned workshop for sub national DRR platform members and stakeholders in Nakuru.

This manual is developed by Nicodemus Nyandiko, a DRR analyst.

Glossary of Common Terminologies

Hazard

A potentially damaging physical event, human activity or phenomenon with a potential to cause loss of life or injury, property damage, social and economic disruption, environmental degradation among other effects.

Vulnerability

Vulnerability refers to a set of conditions resulting from physical, social, economic and environmental factors, which increase the susceptibility of a community to the impact of disasters. Vulnerability also refers to the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of natural hazards.

Disaster

A disaster can be defined as a serious disruption of the functioning of the society causing widespread human, material or environmental damage and losses which exceed the ability of the affected community to cope using their own resources.

Risk

Risk is the probability of harmful consequences or loss resulting from the interaction between natural hazards and vulnerable conditions of property and people.

Mitigation

Short and long-term actions, programmers or policies implemented in advance of a natural hazard or in its early stages, to reduce the degree of risk to the people, property, and productivity capacity.

Preparedness

Pre-disaster activities designed to increase the level of readiness or improve operational capabilities for responding to an emergency.

Response

Actions taken immediately before, during or directly after a disaster to reduce impacts and improve recovery from disaster effects.

Impacts

Specific effects of hazards or disasters also referred to as consequences or outcomes.

Acronyms and Abbreviations

ALRMP	Arid Lands Resource Management Project
AP	Administrative Police
ARV	Anti-retroviral treatment
ASAL	Arid and semi arid land
AU	Africa Union
CBSE	Central Board of Secondary Education
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organization
DDMT	District Disaster Management Team
DDMU	District Drought Management Unit
DEPHA	Data Exchange Platform for Horn of Africa
DMC	Drought Monitoring Centre
DSG	District Steering Group
EDRP	Emergency Drought Recovery Project
EIA	Environmental Impact Assessment
EMCA	Environment Management and Coordination Act
GoK	Government of Kenya
GSU	General Service Unit
HFA	Hyogo Framework for Action
ICPAC	IGAD Climate Predictions and Applications Centre
ICSU-ROA	International Council for Scientific Union - Regional Office for Africa
IDPS	Internally Displaced People
IGAD	Intergovernmental Agency for Agricultural Development
ITNS	Insecticide-treated nets
KEMRI	Kenya Medical Research Institute
KMD	Kenya Meteorological Department
KPLC	Kenya Power and Lighting Company
LLITNs	Long-lasting insecticide-treated nets

MAM	March, April & May
MDGs	Millennium Development Goals
NAPDD	National Action Programme for Combating Drought and Desertification NDCF - National Drought Contingency Fund
NDOC	National (Disaster) Operations Centre
NEPAD	New Partnership for Africa's Development
NOAA	National Oceanic and Atmospheric Administration
NTEWC	Tsunami Early Warning Centre
NTIC	National Tsunami Information Centre
NYS	National Youth Service
OCHA	Office for the Coordination of Humanitarian Affairs
OFDA-CRED	Office of U.S. Foreign Disaster Assistance-Centre for Research on the Epidemiology of Disasters
OND	October, November & December
POA	Programme of Action
ROK	Republic of Kenya
SAR	Search and Rescue
UNESCO	United Nations Educational Scientific and Cultural Organization
UNISDR	International Strategy for Disaster Reduction
WARMA	Water Resources Management Authority
WCDR	World Conference on Disaster Reduction
WWSSN	World Wide Standardized Seismic Network

1. Introduction

1.1 Background

Kenya has become increasingly predisposed to a variety of natural and man-made disasters including floods, drought, landslides, fires, HIV/AIDS, terrorism among others. Disaster impacts cause enormous suffering including loss of life, disruption of livelihoods and of economic activities and degradation of the environment. The government of Kenya, in recognition of the need to minimize disaster impacts has embarked fully on disaster management strategies aimed at risk reduction in support of sustainable development objectives. It is in this context the government has put in place legal, institutional and administrative measures aimed at strengthening capacity and strategies to be taken before, during and after disasters. The policies and institutional mechanism the government has developed include: development of national disaster policy, establishment of national disaster reduction platforms, strengthening institutions tackling disaster risk reduction (DRR) related tasks and developing hazard maps. Increasing stakeholder awareness on natural hazards in Kenya is critical to developing programs and projects that are resilient to disaster impacts in support of sustainable development.

The UNISDR and Ministry of State for Special Programmes (MoSSP) has supported establishment of district specific hazard fact sheets which has been utilized to develop this training package for DRR stakeholders in addition to other information sources and the existing disaster preparedness and response measures. This training manual aims at building capacity of the DRR platforms at all levels and other relevant actors to design and implement development projects that enhance protection of lives and livelihoods while improving environmental quality and protecting ecosystem services.

1.2 Rationale of the natural hazard fact sheet training

In the past two years Kenya has suffered massive decline in economic growth due to high population pressure, widespread poverty and 2007/8 post election violence. This has been compounded by the global economic recession and natural disasters. **Natural hazards** in Kenya include frequent drought episodes, floods, wild fires, landslides among others. The hazards on their own are not dangerous but when they interact with people or their assets, they can cause damage of varying magnitude resulting into **disasters**.

Disasters disrupt people's lives through displacements, deaths and injuries. They destruct livelihoods and drain years of economic gains and development. **Natural disasters** for instance cause loss of lives and property, displacement of people from homes, destruction of infrastructure like roads, rails and telecommunication lines, contamination of water sources causing diseases or depletion of the same altogether. The magnitude of a **disaster** depends on the **characteristics**, the **probability** and **intensity** of the **hazard** and the **susceptibility** of exposed **elements** based on the prevailing **physical, social and environmental** conditions. Kenya experiences a number of natural hazards, the most common being weather and climate related, including floods, droughts, landslides, lightening/thunderstorms, wild fires, and strong winds. Other hazards experienced in Kenya include HIV/AIDS, and conflict. In the recent past these hazards have increased in number, frequency and complexity. The level of destruction has also become more severe with more deaths of people and animals, loss of livelihoods, destruction of infrastructure among other effects

resulting in losses of varying magnitudes. This training manual aims at building DRR capacity of DRR managers and other disaster risk management actors to design and implement programs/projects that enhance protection of lives and livelihoods while improving environmental quality and protecting ecosystem services.

1.3 Objectives of the training course

The overall aim of the training package is to increase awareness on natural hazards and disaster risk reduction to key stakeholders with knowledge on disaster management to empower the actors to support their organizations in developing disaster resilient programs and projects.

This training manual is for use in DRR training aimed at building the capacity of sub national government officials, NGOs, academia and other actors responsible for delivering, implementing, planning, researching or coordinating programs/policies and projects by raising awareness on DRR issues. The knowledge shared through this toolkit will help participants increase their knowledge of preparedness; response, recovery, rehabilitation and development projects/ programs that incorporate DRR concerns. At the same time, the package also aims at raising awareness of DRR practitioners on various hazards in Kenya, their potential impacts, temporal and spatial distribution and possible mitigation measures.

1.3.1 Specific objectives

At the end of the training course it is expected the participants will be able to:

- Identify global and regional typology of hazards including their spatial and temporal distribution
- Identify and understand the causes and impacts of various hazards in Kenya
- Understand disaster risk reduction concepts and DRR conceptual frameworks and institutional mechanisms
- Identify disaster risk reduction strategies and opportunities in programming

1.4 Expected outcome

The training package is expected to achieve the following goal:

Taking the objectives into account, the package is expected to enhance knowledge of national and district level disaster risk reduction government, NGOs, civil society, media personnel and other actors so as to achieve substantive results on reduction of disaster losses, in lives and in the social, economic and environmental assets of communities.

1.5 Training methods

The following training methods are planned for use during workshops:

- Power point presentations
- Group discussions
- Group exercises
- Supplementary handouts
- Review sessions

1.6 Course duration

The course is designed to take a maximum of two days

1.7 Target group/participants

The target group includes:

- District DRR platform stakeholders
- Sub National DRR platform members/ stakeholders
- Academic institutions
- Emergency responders

The course will be helpful to practitioners who are involved in: Developing and implementing DRR policies, plans and projects.

1.8 Course structure and contents

The course is structured in nine (9) modules. Hereunder is a brief description on each of the module.

Module 1: Introduction to disaster risk reduction

The course would start with an introductory session, which would establish the importance of the course for the participants and the skills, technique and knowledge they would acquire at the end of the course. The rationale would be established through citing the impacts of natural hazards on development projects as well as how improper planning and implementation of these projects could lead to increase in risk from natural hazards. Introduction to key concepts and principles used in disaster management such as hazard, disaster, vulnerability, disaster risk and coping will follow. The module will also explore hazard and disaster management at global and regional perspectives including introduction to global trends, disaster risk reduction frameworks, hazards and disaster risk in Africa.

Module 2: Natural hazards and disaster risk reduction in Kenya

The module will highlight typology of hazards in Kenya, temporal and spatial hazard distribution, disaster management legal and institutional arrangements including Kenya disaster policy, legal frameworks and role of relevant DRR institutions.

Module 3: Drought hazard in Kenya

The module will highlight the typology of droughts in Kenya, temporal and spatial distribution and causes of drought. The module will also focus on drought mitigation, prevention and risk reduction measures. The module will have four sessions.

Module 4: Flood hazard in Kenya

The module will cover the following: definition of flood, occurrence of flood in Kenya, mitigation measures and risk reduction strategies. It will also focus on Integrated Flood Management (IFM) in the context of legal, social, economic and environmental aspects

Module 5: Earth/land movement hazards (earthquake, volcano and land slide)

The training will highlight the occurrence, causes, impacts and disaster risk reduction strategies for the following hazards: earthquake, volcano and landslide. The module has three main sessions.

Module 6: Tsunami

The module will highlight the typology of Tsunami, temporal and spatial distribution and causes of Tsunami. The module will also focus on Tsunami mitigation, prevention and risk reduction measures. The module will have four sessions.

Module 7: Lightening and wild fires

The module will focus on the following: Types of lightening, occurrence in Kenya and causes, mitigation strategies and risk reduction measures. The module will also explore the causes and occurrence of fire in Kenya, methods of controlling fire, predicting likely fire impacts and fire hazard mitigation measures

Module 8: Disease pandemics (malaria and cholera)

The module will highlight the types of Malaria/cholera in Kenya, temporal and spatial distribution and causes of Malaria/ Cholera. The module will also focus on Malaria mitigation, prevention and risk reduction measures. The module will have four sessions.

Module 9: Disaster preparedness and Early Warning

The module will highlight disaster

preparedness and response mechanisms with DRR perspective including: Components of disaster preparedness, Contingency planning, response strategies, rehearsals, resource mobilization and hazard monitoring and early warning.

1.9 Proposed profile of trainers

It is proposed that the training will be delivered by a wide range of trainers drawn from various partner agencies with respective expertise on disaster management, DRR, ecosystem and environmental management and working closely with governments at National and sub national levels. It is proposed to draw a pool of trainers with experience in programs and projects in DRR.

1.10 Usage of the training manual

The training package is developed for training participants at sub national level. It is intended to guide facilitators during training of trainers' (ToT) training during delivery of the training course, as a companion document to the power point presentations. It would also be used by learners on self study aimed at enhancing knowledge sharing and learning process on the issue of DRR. It is believed that the participants attending the training course would find the manual handy in terms of getting introduced to key concepts for each of the session, reinforced with case studies from Kenya and other regions to support the learning process. In addition, wherever applicable Case Studies are provided to elaborate the key concepts which the session aims to convey to the participants. An attempt has been made to capture case studies for the sake of familiarity of the participants who are expected to be from the Kenya.

2. Training Modules

2.1 Module 1: introduction to disaster risk reduction

The module will cover the following contents to be delivered in five sessions:

i. Climate setting
ii. Module learning objectives
iii. Knowing each other and the resource persons better
iv. Listing out the expectations from this training course
v. Understanding the importance of this course and how it would help in their professional work
vi. Introduction to disaster risk reduction will include the following disaster management terminologies and key concepts:
    - Hazards, disaster, disaster risk, vulnerability coping and vulnerability
    - Classification of hazards and disasters
    - Disaster elements and disaster cycle
    - Overview of hazards/disasters (global and regional perspectives),
    - Disaster risk reduction legal frameworks and institutional mechanism

2.2 Session1: Knowing the participants

At the end of the session the participants would be able to know each other better and the training resource persons

Session delivery: The session would be delivered through an exercise involving each of the participants.

Materials required: Paper, pen, masking tape

Instructions: Provide each participant with a piece of paper and a pen and ask them to write their names on the top.

Suggest participants spend at least thirty seconds talking to one another.

2.3 Session 2: Expectation setting

Session learning objective: At the end of the session the participant would be able to list out their expectations from the training course.

Session delivery: Session will be delivered through an exercise involving each of the participants.

Materials required: Colored cards, papers, tape board.

Instructions: Provide each participant with3 pieces of colored paper and request them to write their expectations from the training course

Give around 10 minutes to the participants to write the expectations which are to be grouped by the facilitator

After all the expectations are written, the facilitator shall group them.

2.4 Session 3: Why this course?

Session duration: 15 Minutes

The session will highlight the following:

i. Kenya's landscape covers a total of 583,000 sq. km. The population growth rate of 3.1% and the population stands approximately 40 million people. The country's GNP is close to US $ 330

ii. The population is predominantly rural and relies on agriculture which contributes about 28% of the country's total GDP
iii. Natural hazards in Kenya include drought, floods, earthquakes, volcanic eruptions, landslides among others. These occur all over the world and on their own are not harmful
iv. When natural hazards interact with vulnerable populations such as people, property or livelihoods, they cause disasters
v. Natural disasters continue to strike and increase in magnitude, complexity, frequency and economic impact. The cyclic nature of disasters in Kenya has constantly eroded the recovery capacity of communities. They have taken back years of development thus posing a major challenge to the achievement of Millennium Development Goals (MDGs)
vi. Whereas the natural phenomenon (hazards) causing disasters in most cases beyond human control, the vulnerability is generally a result of human activity
vii. There is now international and national acknowledgement that efforts to reduce disaster risks must be systematically integrated into policies, plans and programmes for sustainable development and poverty reduction, and supported through bilateral, regional and international cooperation, including partnerships.
viii. Understanding characteristics, nature and probability of occurrence of hazards is one such effort. An integrated, multi-hazard approach to disaster risk reduction should be factored into policies, planning and programming related to sustainable development, relief, rehabilitation, and recovery activities in post-disaster and post-conflict situations in disaster-prone areas

2.5 Session 4: Understanding language of disaster risk reduction

At the end of the session, the participants should be able to:

- Define and understand common key terms used in disaster risk reduction
- Classify disasters based on causative factors; Understand the concept of disaster cycle
- Discuss the causal phenomenon of each disaster
- Describe the cycle of common disasters in Kenya
- Understand the global and regional perspectives of hazards and disasters
- Understand and apply the disaster risk framework

Session duration: 45 Minutes

2.6 Understanding disaster risk reduction language

- Define and understand key terms (event, hazard, disaster, vulnerability, coping, disaster risk and vulnerability)
- Give examples of common events, hazards, disasters
- Categorize common events, hazard or disaster
- Understand vulnerability, hazard and disaster risk
- Understand disaster risk reduction and how it is linked to sustainable development

2.6.1 Defining the word "event"

An event refers to anything that happens or takes place. Some happenings occur naturally without the control of human beings such as breathing. Other happenings are planned to occur such as walking and driving.

Can you give five examples of happenings or occurrences?

Some events are undesirable or harmful such as a road accident or a heavy storm. A heavy storm is a natural event while a road accident is man- made event.

What are the effects of an undesirable event such as a storm?

- Destroys the environment (degradation)
- Can drown people (kill)
- Destroy crops and drown livestock
- Damage houses (residential, schools, hospitals etc)
- Damage roads

2.6.2 Defining the word "hazard"

Hazard is an expression that refers to the potential harmful effect of an event. A more standard definition of the word hazard is a 'natural or man-made phenomenon which may cause physical damage, economic losses, or threaten human life and well-being if it occurs in an area of human settlement, agricultural or industrial activity'. In engineering, the term is used in a more specific, mathematical sense to mean the probability of the occurrence, within a specified period of time and a given area, of a particular, potentially damaging phenomenon of a given severity/intensity.

Therefore hazards are events that are:

- Extreme
- Excessive
- Abnormal
- Unwanted

2.6.3 Defining the word "disaster"

When a hazard does occur, there is an effect on society. For example when lightening does occur in a crowded stadium, many people may perish; others get injured and destroy facilities. The effect is on people and property and that is what is referred to as society and the society is seriously disrupted. The effect on people includes death, injury, and pain: both physical and psychological. The effect on property includes damage, loss, destruction and deformation.

Thus, a disaster unlike a hazard is an effect.

What level of effect?

The effect of a disaster must be overwhelming beyond the capacity of the affected society to cope. Thus a disaster is defined as a "serious disruption of the functioning of the society causing widespread human, material or environmental damage and losses which exceed the ability of the affected community to cope using their own resources". Two conditions MUST be met when a disaster happens: there must be an effect on society and the effect must be to such level that the society is overwhelmed. Thus a disaster can be defined as a "serious disruption of the functioning of the society causing widespread human, material or environmental damage and losses which exceed the ability of the affected community to cope using their own resources".

Table 2.1: Hazardous events

Event	Hazardous Level	Tale-tale Signs
Rain	Floods (heavy rainfall)	Washes away crops
Wind	Strong winds	Damage roofs
No rain	No rain for long period	Drought, famine
Lightening	Lightening strike in a crowded room	People killed and maimed

Assignment 1.1

i. Give three examples of each of the following; events, natural hazards, man-made hazards
ii. Discuss why a hazard may be a disaster in one location and not in another
iii. Distinguish clearly the meaning of the words hazard and disaster

2.6.3.1 Classification of disasters based on causative factors

Disasters can be classified based on the nature of the causative factors namely: natural or manmade.

Natural disasters
These are disasters caused by natural hazards. Examples are floods, earthquakes, drought, lightening, Cyclones and tsunami.

Human made (Anthropogenic) disasters
These are disasters linked to human-made hazards. Examples are war, technological disasters, foreign fauna, HIV/AIDS pandemic, bomb blast and environmental disasters.

2.6.3.2 Classification based on origin of disasters

The table below summaries this type of disasters

Assignment

a. Can you name another two disasters for each of the above categories?
b. Can you fill the table 2.3 with appropriate examples of the disasters in each category?

2.6.3.3 Classification of disasters based on time of onset

Based on time of on-set, disasters can be classified as:

Rapid onset disasters (RODS)
These disasters happen over relatively short period of time such as seconds, minutes or hours. For example; lightening, earthquake, bomb blast, tsunami and flood.

Slow onset disasters (SODS)
These disasters take a relatively long period of time to occur. Examples are famine, drought, locust invasion, HIV/AIDS pandemic, war and frost.

2.6.3.4 Disaster cycle and disaster risk reduction

The "disaster cycle":
Disaster cycle or management cycle illustrates the going process by which disaster managers and society plan for and reduce the impact of disasters, react immediately following a disaster, and take steps to recover after a disaster has occurred. Disaster managers and society should always expect disasters to happen

Table 2.2: Classification of natural hazards

Category	Types of Hazards
Geological hazards	Earthquakes, tsunamis, volcanic eruptions, and landslides
Hydro-metrological hazards or hydro-climatological	Droughts, floods, cyclones, tornadoes, hurricanes, hailstorms, heat waves, cold waves
Biological hazards	Disease epidemics, pest attacks, invasive species
Environmental hazards	Desertification, deforestation, soil erosion, environnemental pollution

Table 2.3: Natural and human-made disasters

Examples	Natural Disasters		Human Made Disasters	
	Slow On-set	Fast On-set	Slow On-set	Fast On-set
1				
2				
3				
4				
5				

and be prepared. Appropriate actions at all points in the cycle lead to greater preparedness, better warnings and reduced vulnerability or prevention of disasters during the next iteration of the cycle. This facilitates disasters to be analyzed in the framework of their occurrence, relief, rehabilitation, mitigation, disaster preparedness and response. This concept is referred to as disaster cycle, in what we call the phases of a disaster.

Preparedness phase
The goal of this phase is to develop measures in advance to ensure a satisfactory level of readiness to respond to any emergency through programs that strengthen the capacity of the society and the disaster managers. This includes issuance of timely and effective early warnings and temporary evacuation of people and property from threatened locations. This is the time for planning and being prepared for the disaster.

Impact phase
It is marked by overwhelming disruption of the local community at the interception region beyond their capacity to withstand the effects of the hazard. It is marked by high degree of chaos but it could have a remarkable degree of organization depending level of organization and effectiveness of disaster risk reduction and mitigation measures put in place before the disaster.

Relief/response phase
Begins when assistance arrives from outside the disaster area to support the disaster victims to maintain life, improve health and sustain the morale of the affected population. Such assistance ranges from evacuation, temporary shelter, food, education, medicine and water. Disaster reliefs need to be integrated into development planning and local capacities to strengthen sustainability of the interventions.

Recovery phase
It is characterized restoring pre-disaster conditions and undertaking activities restoring their lives and infrastructure. However, there is no distinct point at which immediate relief changes into recovery and then into long term sustainable development. There are many opportunities during recovery period to enhance prevention, disaster preparedness, reduce vulnerability and sustainable development. Recovery efforts include returning life support systems to minimum operating standards; temporary housing, public information, health and safety education; reconstruction; counseling programs and economic impact studies. These interventions need to be tailored to ensure the society is built back better to withstand future hazards.

Mitigation phase
Involves establishing structural and non-structural measures undertaken

to limit the adverse impact of natural hazards, environmental degradation and technological hazards aimed at reducing disaster occurrence or reducing the effects of unavoidable disasters including building codes, vulnerability analyses and updates; zoning and land use management; safety codes; preventive health care and public education.

Figure 2.1: Disaster cycle

What causes disasters?

Disasters, whether natural or manmade, do not just happen. Favorable conditions must exist for a disaster to happen. The causative factors for each disaster can easily be enumerated.

Box 2.1:Illustration of drought causal phenomenon

Illustration: Causal factors of drought and famine in Kenya

i. Climatic changes (drought)
ii. Loss of soil fertility
iii. High Population
iv. Land fragmentation
v. Poor seed quality
vi. Pests and diseases
vii. Poor agricultural policy
viii. War and conflict
ix. Pest and disease infestation

2.6.4 Hazard, vulnerability and disaster risk

Disaster risk

Risk refers to expected lives lost, property damaged and economic losses. It is probability of a disaster happening in an area. Two elements are essential in the formulation of risk: a potential damaging event, phenomenon or human activity – hazard; and the degree of susceptibility of the elements exposed to that source – vulnerability. Therefore Risk is the expected or anticipated losses (lives lost, people injured, property damaged, and economic activities or livelihoods disrupted) from the impact of a given hazard on a given element at risk over a specific period of time. Risk has two components-hazard and vulnerability.

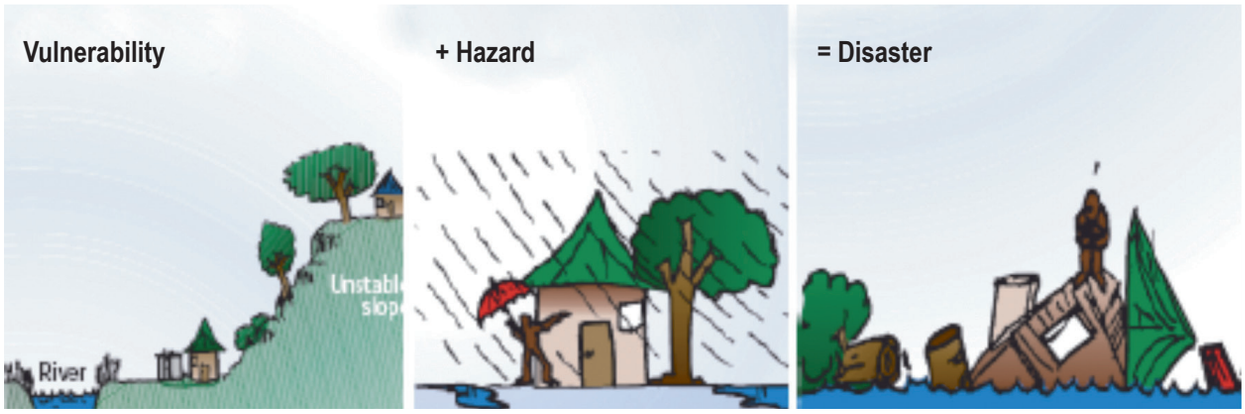
Risk notation

Risk = Hazard x Vulnerability/Capacity

Risk assessment

Refers to a methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend.

Many tools are available for carrying out risk assessment which ranges from



mathematical models, statistical models, access model, SWOT analysis, GIS tools, Risk mapping, remote sensing, cost benefit analysis and Environment Impact Assessment.

Disaster risk management involves;

- **Risk identification** – Making informed decisions on where to invest and how to design sustainable projects that will withstand the impacts of potential disaster events including identification of hotspots
- **Risk reduction** - The second component of an effective risk management strategy is to reduce risk, including strategies to avoid hazards (e.g., land use and development planning) and resist disaster impacts (e.g., building codes, socio-organizational measures). Examples of this work include the development of methodologies to assess damage and needs and the evaluation of recent experiences in reconstruction after major disasters (e.g., Hurricane Mitch, floods in Mozambique)
- **Risk transfer** - The third component of the risk management strategy is transferring, or sharing the risks that cannot be reduced. This includes efforts that protect development investments and advance disaster risk awareness, including traditional insurance mechanisms, safety nets, calamity funds, or informal insurance arrangements. A good example in on weather index insurance plans in Malawi

Disaster risk reduction and mitigation measures

The techniques or measures that an authority might consider in assembling an appropriate package for disaster mitigation can be classified as:

1. Physical planning measures
2. Economic measures
3. Management and institutional measures
4. Societal measures

1. Physical planning measures

Careful location of new facilities particularly community facilities such as schools, hospitals and infrastructure, plays an important role in reducing vulnerability. In urban areas, deconcentration of elements especially at risk is an important principle. This principle also applies to population density: a denser concentration of people will always increase the potential for disaster compared to a more dispersed population. On the other hand dry lands, flood plains and steep slopes are often the marginal lands that are available to the lower-income communities and the most vulnerable social groups. The economic pressures that drive these groups first to the city for jobs and opportunity and second to the marginal lands to live need to be fully understood at the context for reducing their risk. Prohibition or measures to clear

settlers from hazardous areas are unlikely to be successful for long if the background pressures are not addressed.

2. *Economic measures*

Equitable economic development is the key to disaster mitigation. A strong economy in which the benefits are shared throughout the society is the best protection against a future disaster. A strong economy means more money to be spent on land management measures and larger financial reserves to cope with future losses. The interdependency between Disasters and Development cannot be overemphasized.

Inevitably it is those who have least that, proportionally, lose most in a disaster. The weakest members of the economy have few economic reserves. If they lose their crops or their animals they have no means of recovering them. They are unlikely to have insurance or access to credit and can quickly become destitute. Rehabilitation plans often extend generous loans to victims to aid their recovery but a family without an income has little prospect of making repayments and is therefore unable to benefit.

Some aspects of economic planning are directly relevant to reducing disaster risk. Diversification of economic activity is as important economic principle as deconcentration is in physical planning. A single industry (or single-crop) economy is always more vulnerable than an economy made up of many different activities. The linkages between different sectors of an economy - the transportation of goods, the flow of information, and the labour market - may be more vulnerable to disruption from a disaster than the physical infrastructure that is the means of production.

3. *Management and institutional measures*

Disaster mitigation also requires certain organizational, management and procedural measures. The objectives and policies that guide the mitigation processes have to be sustained over a number of years, and have to survive the changes in political administration that are likely to happen within that time, the changes in budgetary priorities and policies on other matters. The institutionalization of disaster mitigation requires a consensus of opinion that efforts to reduce disaster risk are of continual importance. ***Education, training and professional competence, and political will, are necessary aspects of institutionalizing disaster risk reduction and mitigation.***

Information is a critical element in planning for disaster mitigation, e.g. the basic meteorological observatories to monitor hazards have to be a continuous activity. Research, technical expertise and policy-making organizations are important resources for developing mitigation strategies both nationally and locally. At the local level, community-based mitigation requires the strengthening of the capability of the local institutions to carry out local protection measures – such training and support can often be carried out most effectively by national or international NGOs.

4. *Societal measures*

The mitigation of disasters will only come about when there is a consensus that it is desirable, feasible and affordable. In many places, the individual hazards that threaten are not recognized, the steps that people can take to protect themselves are not known and the demand of the community to have themselves protected is not forthcoming or recognized. ***Mitigation planning should aim to develop a disaster "safety culture" in which the people are fully aware of the hazards they face, protect themselves as fully as they can and fully support efforts made on their behalf to protect them.***

Reminders of past events locally aid the awareness of risk. The objective is to

develop an everyday acknowledgment of hazard safety where people take conscious, automatic precautions through being aware of, but not terrified of, the possibility of hazard occurrence. Their understanding should include being aware of what to do in the event, and a sense that their choice of crops, land management practices, environmental awareness all affect their own well-being.

Community-based mitigation requires the strengthening of the capability of local institutions to formulate plans, to manage local protection measures and to negotiate with government to provide assistance. Involvement of the community in mitigation planning processes may involve public meetings and consultations, public inquiries and full discussion of decisions in the normal political forum.

Timing of mitigation activities - Opportunities for mitigation: post-disaster implementation

Successful mitigation entails a number of fundamental changes in the attitudes of the people at risk, in the processes of creating and modifying the physical environment and in the physical layout of a community. These changes take time.

Occasionally mitigation projects are prompted by predictions and studies of the likely consequences of hazards but in many cases implementation of mitigation comes about mainly in the aftermath of disaster. Rebuilding what has been destroyed and recognition that the damage was avoidable can generate protection against a future disaster. Public support for mitigation action is strong with the visible evidence and recent memory of the disaster, or the knowledge of a disaster elsewhere.

Hazard-specific programs tend to follow the occurrence of a particular hazard: A drought disaster tends to lead to drought mitigation.

The best opportunity to implement a disaster mitigation program is in the immediate aftermath of a disaster. The experiences of the disaster, the reconstruction and the mitigation measures it engenders should be exported with relevant adaptations to the places that need it most.

The time immediately following a disaster is a good time to initiate disaster mitigation programs due to the fact that:

- public support is strongest immediately after a disaster
- the community is involved in active reconstruction
- International or local aid may be focused on the community

Even with these advantages there may be some problems associated with mitigation measures that are based on reaction to a recent disaster. Mitigation measures may be based exclusively on the recent hazard type even though other hazards may be more likely to strike next. Mitigation may be focused on the area worst affected by the disaster even though other areas may actually be more at risk.

Q. It is argued that the best time to implement a disaster mitigation program is in the aftermath of a disaster. Why is this so? Even though the aftermath of a disaster is fertile ground for mitigation activities, there are some possible drawbacks as well, what are they?

A: _____

Vulnerability

Vulnerability is the extent to which one group or socio economic structure is likely to be affected by a hazard. It is influenced by the **physical, social, economic,** and **environmental** factors and coping capacity of the **society** for the elements at risk. Recent disaster statistics point to a steep rise in deaths and injuries as a result of disasters. This rise is not always accompanied by a parallel rise in number of disasters such as earthquakes, floods, drought and the like. What is changing is the in the **effects** of disasters, in other words **vulnerability**.

On the other hand, **coping** refers to the capacity of the stricken community to adjust their way of life based on their experiences with living with hazards. For example, many families in arid and semi arid lands (ASAL) are vulnerable to food shortages as a result of drought; but they are able to prevent full blown famine occurring by employing a variety of coping mechanisms that allow them to ride to the hungry season until the next harvest.

The concept of **vulnerability** is applied to explain why **elements** are affected differently by exposure to risks and shocks. **Vulnerability**, in its simplest denotative sense, means the capacity to be harmed. This meaning relates vulnerability to **sustainability**, which in many of its meanings means the capacity to persist. Therefore, it is the characteristics of populations, activities, and the environment that make livelihoods susceptible to the effects of a shock or stress event, for example drought.

Human vulnerability is the relative lack of capacity of a person or social group to anticipate, cope with, resist, and recover from the impact of a hazard. Vulnerability has two components: exposure to hazards (e.g. drought, earthquake, etc.) and difficulty in coping with and recovering from them (due to lack of resources). Human vulnerability is inversely related to the concept of human capacity.

Structural or physical vulnerability is the extent to which a structure or service is likely to be damaged or disrupted by a hazard event. A building is said to be vulnerable to earthquake tremors if its construction lacks elements which would resist the effects of such tremors.

Vulnerability assessment provides a framework for identifying or predicting the underlying causes of hazard-related impacts. For example, drought may only be one factor along with other adverse social, economic, and environmental conditions that creates vulnerability.

Capacities: ***Human capacities*** are the qualities and resources of an individual or community to anticipate, cope with, resist and recover from the impact of a hazard. According to Mary Anderson's People-Oriented Planning (POP) framework, human capacities include a person's or a community's material resources (food, animals, tools); social and organizational capacities (leadership, community groups); and attitudinal and motivational capacities (ideas, work values, efficacy).

Factors affecting human vulnerability

It is important to understand some of the major factors which make a population vulnerable. These factors include:

i. Poverty
ii. Increased population density
iii. Rapid urbanization
iv. Changes in way of life
v. Environmental degradation
vi. Lack of awareness and information
viii. War and civil strife

These seven factors frequently are interrelated.

i. Poverty

Poverty can be viewed quantitatively or qualitatively. In quantitative terms, poverty is defined and measured as the shortfall from an objectively determined level of income or consumption (World Bank 1990, 91). On the other hand, in qualitative terms, poverty is conceptualised as a multi-faceted mix of economic and social factors (Chambers 1988). Poverty can be absolute or relative. **Absolute poverty** is the inability of an individual, household, community or a nation to satisfactorily meet its basic needs. On the other hand, **relative poverty** is the inability to meet perceived needs and desires in addition to basic needs.

Most disaster studies show that the wealthiest members of a population either survive a disaster unaffected or are able to recover quickly. Poverty generally makes people vulnerable to the impact of hazards. Poverty explains why people in urban areas are forced to live on hills that are prone to landslides or why people settle near volcanoes or rivers that invariably flood their banks.

ii. Increased population density

There is an obvious connection between the number and magnitude of losses from a disaster and the size of the population. If there are more people and structures where a disaster occurs, then it is likely there will be more of an impact. Population growth means that more people will be forced to live and work in unsafe areas and that more people are competing for a limited number of resources which may lead to conflict.

iii. Rapid urbanization

Rapid population growth and migration are related to the major phenomenon of rapid urbanization. It is characterized by the rural poor or civilians in an area of conflict moving to metropolitan areas in search of economic opportunities and security. As a result, fewer opportunities are available. Competition for scarce resources can result in human-made disasters.

iv. Changes in way of life

All societies are constantly changing and in a continual state of transition. These transitions are often extremely disruptive and uneven and may leave gaps in social coping mechanisms. These transitions include nomadic populations that become sedentary, rural people who move to urban areas, and both rural and urban people who move from one economic level to another.

When people move from rural to urban centers, they may lose the social support system or network that traditionally would have assisted them in recovering from a disaster. Since these traditional coping mechanisms may not exist in the new setting, the population increasingly depends on outside intervention to help in the recovery process. Conflicting as well as transitional cultural practices can lead to civil conflict, for example, as a result of communal violence triggered by religious differences.

v. Environmental degradation

Many disasters are either caused or exacerbated by environmental degradation. Deforestation leads to rapid rain runoff, which contributes to flooding. For example the creation of drought conditions—and the relative severity and length of time the drought lasts is mainly a natural phenomenon, but agricultural development and the system of food distribution may exacerbate conditions. Similarly, climate changes, which are presumed to be a result of the phenomenon of global warming, may result in more disasters due to such hazards as flooding and desertification.

vi. Lack of awareness and information

Disasters can also happen when people who are vulnerable to them simply do not know how to get out of harm's way or what protective measures to take. There may be a lack of awareness about what measures can be taken to build safe structures on safe locations. Some people may not know about safe evacuation routes and procedures whereas others may not know where to turn for assistance in times of acute distress. In most disaster-prone societies, however, there is a wealth of understanding about disaster threats and responses.

vii. War and civil strife

War and civil strife can be regarded as hazards, that is, extreme events that produce disasters. War and civil strife often result in displaced people who are more vulnerable as a result of their dislocation. Causes of war and civil strife include competition for scarce resources, religious or ethnic intolerance, and ideological differences the same factors that increase vulnerability to disasters.

2.7 Global and regional perspectives of hazards and disaster risk reduction

2.7.1 How have hazards and disasters shaped global disaster risk reduction agenda?

In the final years of 1990s, several powerful disasters occurred in different parts of the world, in countries large and small, industrialized or agrarian, technologically sophisticated or traditional focused. The natural hazards that triggered these disasters varied from the seemingly unexpected earthquakes to more predictable seasonal floods and periodic storms. The media images of natural disasters underscored the human consequences and social dimension of these events. Examples of these disasters include:

i. Hurricane Mitch: The power and damage of Hurricane Mitch can be recalled with a lot of nostalgia. Hurricane Mitch struck Honduras and Nicaragua in 1998 destroying up to 70% of infrastructure, devastating the

A case of urban vulnerabilities

In an urban area prone to flooding, some houses have been constructed in a low-lying area close to the riverbank. They are made of concrete blocks and have basements or are on raised foundations. Other houses are made of cheaper Materials, do not have basements, are not on a raised foundation, and have been erected in or very near a dry riverbed. When heavy rains fall upstream and cause flooding, this hazard does not affect the houses or their occupants equally. If flooding occurs, the water may wash through the basements or foundations of the concrete buildings but leave the structures reasonably intact. In or near the riverbed, however, the fragile dwellings will be completely destroyed, leaving many inhabitants without houses. The economic vulnerability of the riverbed dwellers forced them to live in what they know is a potentially dangerous site. Their property is structurally more vulnerable than the concrete buildings. The hazard was potentially the same for both groups of inhabitants. It is the vulnerability (economic and structural) that has increased the risk for one group.

Two examples of risk reduction could be the following:

- A civil engineering measure to control the river flow-rate up-stream during the rainy season.
- Beneficiaries may be asked to provide their labour as an in-kind donation to the project.
- An expansion of employment opportunities or relocation to structurally sound accommodations outside the river may reduce the vulnerability of river dwellings.

(Source: IFRC, 2000)

economy of all the Central American countries, which are yet to recover fully

ii. Cyclone Orissa: In 1999, the worst cyclone in 100 years struck Indian state of Orisa, affecting ten times as many people as cyclone Mitch. In 1999, unprecedented floods hit villages in Mexico leaving over 300,000 people homeless

iii. El Nino: The extra ordinary El Nino events of 1997-1998 caused extensive flooding around the globe destroying infrastructure, crops and farmlands

iv. Drought: The frequent drought episodes in the Horn of Africa have led to loss of livestock, dead of people and slowed economic growth

v. Landslide: The extraordinarily heavy rainfall associated with Hurricane Mitch caused a landslide at the Casita in Nicaragua that was 18 kilometers long and 3 kilometers wide. It totally destroyed three towns and killed more than 2,000 people. Less than two years later, one of the earthquakes in El Salvador caused a landslide that buried almost 700 houses of a well established neighborhood

vi. Tsunami: The December 26 earthquake and tsunami devastated the lives of millions of people around the globe, leaving a wake of destruction from Asia to Africa. This was the worst natural disaster in South East Asia's history. Over 250,000 people lost their lives, an estimated one million people were displaced, and many orphaned. The scale of the damages to the local economy, infrastructure, and administration were unprecedented. In an instant, the livelihoods and security of hundreds of thousands of the survivors were ruined

In general, the drama of such disasters and the urgent international activity to provide emergency relief commands the attention of the international media only for a few days. However, the consequences of disasters linger much longer and are not clearly measurable-lives lost, livelihoods disrupted, property destroyed and environment damaged. These losses impede human development and erode previously hard-worn society's accomplishments. They also compromise resources for current and future generations.

Paradigm Shift to disaster risk reduction

People involved in disaster management have progressively recognized the essential public value of sustained efforts to reduce the social, economic and environmental costs of natural hazards. This therefore recalls for strategies that contributes to saving lives and protecting property and resources before they are lost. The shift in the approach from disaster response to disaster reduction has been motivated by a number of factors mentioned above including the high frequency and intensity of disasters in the past two decades, the international decade for natural disaster reduction which raised awareness on natural hazards and the land mark World Conference on disaster reduction held in Hyogo, Japan in 2005.

2.7.2 The Hyogo Framework for Action (HFA)

2.7.2.1 Defining hyogo framework of action

Disaster risk reduction (DRR) is the conceptual framework of elements considered with the purpose of minimizing vulnerabilities and disaster risks throughout a society in order to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, and facilitate sustainable development. DRR is a cross-cutting and development issue. The process of DRR is a complex one consisting of political, technical, participatory and resource mobilization components.

The landmark 2005 World conference on disaster reduction held in Kobe, Hyogo, Japan:
The World Conference on Disaster Reduction was held from 18 to 22 January 2005 in Kobe, Hyogo, Japan, and adopted the present Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters. The Conference provided a unique opportunity to promote a strategic and systematic approach to reducing vulnerabilities and risks to hazards. It underscored the need for, and identified ways of, building the resilience of nations and Communities to disasters. Hyogo Framework for Action (HFA) provides overall guidance on the possible range of measures that a country or society could implement to reduce disaster risk; the actual measures required will depend on the country's specific risk profile and socio-economic development scenarios. Disaster risk reduction requires concerted action by a wide range of stakeholders including national and local authorities, civil society and non-governmental organizations (NGOs), scientific, technical and academic organizations and the private sector.

Therefore, DRR requires collective wisdom and efforts from national policy and decision makers from various government sectors, and representatives from civil society, including academic institutions, the private sector and the media.

2.7.2.2 *Strategic goals of HFA*

To attain this expected outcome, the Conference resolved to adopt the following strategic goals:

a. The more effective integration of disaster risk considerations into sustainable development policies, planning and programming at all levels, with a special emphasis on disaster prevention, mitigation, preparedness and vulnerability reduction
b. The development and strengthening of institutions, mechanisms and capacities at all levels, in particular at the community level, that can systematically contribute to building resilience to hazards
c. The systematic incorporation of risk reduction approaches into the design and implementation of emergency preparedness

The key activities under HFA's five priorities areas are:

Priority 1: Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation

Key activities:

1. Establishing national institutional and legislative mechanisms
2. Assessing human capacities and allocating resources
3. Promote community participation in disaster risk reduction through the adoption of specific policies, the promotion of networking, the strategic management of volunteer resources among others

Priority 2: Identifying, assessing and monitoring disaster risks and enhances early warning

Key activities:

1. Developing, updating from time to time and widely disseminating risk maps and related information to decision-makers, the general public and communities at risk in an appropriate format through periodic assessments

The HFA Key priority areas for action

1. Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.
2. Identify, assess and monitor disaster risks and enhance early warning.
3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels.
4. Reduce the underlying risk factors.
5. Strengthen disaster preparedness for effective response at all levels.

2. Develop early warning systems that are people centered, in particular systems whose warnings are timely and understandable to those at risk, which take into account the demographic, gender, cultural and livelihood characteristics of the target audiences, including guidance on how to act upon warnings, and that support effective operations by disaster managers and other decision makers
3. Support the development and sustainability of the capacity, infrastructure and scientific, technological, technical and institutional capacities needed to research, observe, analyze, map and where possible forecast natural and related hazards, vulnerabilities and disaster impacts

Priority 3: Using knowledge, innovation and education to build a culture of safety and resilience at all levels.

Key activities:

1. Provide easily understandable information on disaster risks and protection options to encourage and enable people to take action to reduce risks and build resilience. The information should incorporate relevant traditional and indigenous knowledge and culture heritage
2. Promote the inclusion of disaster risk reduction knowledge in relevant sections of school curricula at all levels and the use of other formal and informal channels to reach youth and children with information
3. Promote the engagement of the media in order to stimulate a culture of disaster resilience and strong community involvement in sustained public education campaigns and public consultations at all levels of society

Priority 4: Reduce the underlying risk factors

Key activities:

1. Promote the sustainable use and management of ecosystems, including through better land-use planning, natural resource management and development activities to reduce risk and vulnerabilities
2. Promote food security as an important factor in ensuring the resilience of communities to hazards, particularly in areas prone to drought, flood, cyclones and other hazards that can weaken agriculture-based livelihoods
3. Incorporate disaster risk assessments into the urban planning and management of disaster-prone human settlements, in particular highly populated areas and quickly urbanizing settlements. The issues of informal or non-permanent housing and the location of housing in high-risk areas should be addressed as priorities, including in the framework of urban poverty reduction and slum-upgrading programmers

Priority 5: Strengthen disaster preparedness for effective response at all levels

Key activities:

1. Strengthen policy, technical and institutional capacities in national and local disaster management, including those related to technology, training, and human and material resources including supporting coordination among early warning, disaster risk reduction, disaster preparedness, and response and recovery institutions to foster holistic approach to disaster risk reduction
2. Prepare or review and periodically update disaster preparedness and contingency plans and policies at all

levels, with a particular focus on the most vulnerable areas and groups. Promote regular disaster preparedness exercises, including evacuation drills, with a view to ensuring rapid and effective disaster response and access to essential food and non-food relief supplies, as appropriate, to local needs

3. Promote and support dialogue, exchange of information and coordination among early warning, disaster risk reduction, disaster response, development and other relevant agencies and institutions at all levels, with the aim of fostering a holistic approach towards disaster risk reduction

Assignment:
What is a national DRR platform and what is its role?

2.7.3 Natural hazards – an African outlook

Africa is a continent prone to a wide variety of natural and human-induced hazards and disasters (ICSU-ROA, 2007). In no other continent does drought appear to be as severe a risk as in Africa. Hazards such as floods, hurricanes, earthquakes, tsunamis, droughts, wildfires and pest plagues cause extensive losses to livelihoods and property, and claim many lives every year (ICSU-ROA 2007). In the period 1975–2002, disasters of weather related disasters constituted 59% of the total number of natural disasters that occurred in sub-Saharan Africa, with floods accounting for 27%, droughts 21%, windstorms (particularly tropical cyclones) 9%, and wildfires 1% (OFDA-CRED, 2002; UNISDR, 2004). The vulnerability of Africa's environment is exacerbated by land degradation, which is a major environmental hazard on the continent as well as widespread poverty (ICSU-ROA 2007). Figures 2.4 and 2.5 gives a summary of the typology and natural disasters hotspots in Africa.

2.7.4 African disaster reduction strategies

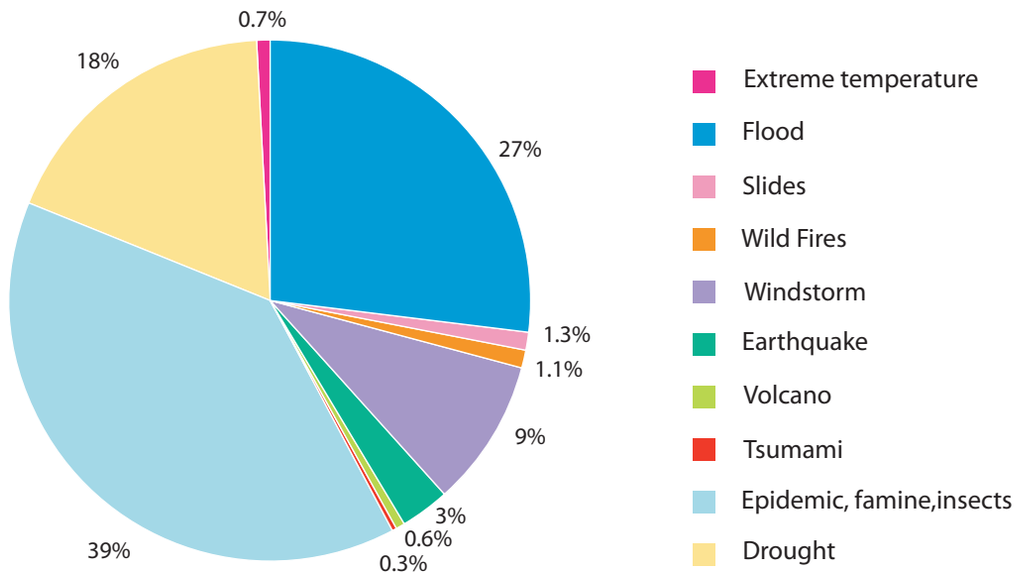
Africa has formulated a continental Programme of Action (POA) for the Hyogo

A National Platform for DRR can be defined as a nationally owned and led forum or committee of multi-stakeholders. It serves as an advocate of DRR at different levels and provides coordination, analysis and advice on areas of priority requiring concerted action through a coordinated and participatory process. A National Platform for DRR should provide the coordination mechanism for mainstreaming DRR into development policies, planning and programmes in line with the implementation of the HFA. It aims to contribute to the establishment and the development of a comprehensive national DRR system, as appropriate to the country. A multi-stakeholder National Platform for DRR can provide or mobilize the combined knowledge, skills and resources required for DRR and its mainstreaming into development policies, planning and programmes. It also can provide the following value added services:

- Engaging higher-level policy makers through advocating for DRR and for mainstreaming DRR into development policies, planning and programmes as well as humanitarian assistance; Poverty Reduction Strategy Papers and Vision 2030.
- Stimulating development actors and planners' active participation in mainstreaming DRR into sustainable development agenda, including the Millennium Development Goals, Providing opportunities for civil society, especially Non-Governmental Organizations (NGO) and Community Based Organizations, to dialogue and contribute to advancing the DRR process in the context of local development;
- Facilitating dialogue and partnership within the international community, including the UN System, regional and national authorities, especially through established National Platforms for DRR;
- Facilitating information sharing, knowledge exchange and technology transfer among members of National Platforms for DRR and between National Platforms for DRR; and
- Increasing access and linkage of existing DRR actors with other relevant bodies at national, regional and global levels.

Source: UNISDR, 2005.

Figure 2.4: Typology of natural hazards in Africa



Source: ICSU-ROA 2007

Framework of Action (HFA). The overall goal of the Africa-POA is to reduce the social, economic and environmental impacts of disasters on African people and economies, thereby facilitating the achievement of the MDGs and other developmental goals in Africa. The key components in the POA include (a) Advocacy and Public Awareness, (b) Capacity Building and (c) Pilot Projects for Mainstreaming Disaster Risk Reduction in Development. In 2004, the Africa Union (AU) and the New Partnership for Africa's Development (NEPAD) developed an Africa Regional Strategy for Disaster Risk Reduction (AU/NEPAD/ISDR 2004). The key objectives of the Strategy are to:

i. Increase political commitment to disaster risk reduction
ii. Improve identification and assessment of disaster risks
iii. Enhance knowledge management for disaster risk reduction
iv. Increase public awareness of disaster risk reduction
v. Improve governance of disaster risk reduction institutions, and
vi. Integrate disaster risk reduction in emergency response management

The African DRR Strategy has integrated its objectives with the Hyogo Framework for Action priorities.

3. Module 2: Natural Hazards and Disaster Risk Reduction in Kenya

Learning objectives

- Understand the historical background of hazards and disaster risk reduction in Kenya
- Identify major types, occurrence and distribution of natural hazards in Kenya
- Identify and Understand the causes and impact of natural hazards in Kenya
- Understand hazard mitigation measures and role of the community in disaster management
- Understand Kenya disaster risk reduction legal and institutional frameworks and mechanisms.

Time: 45 Minutes

Presentation method

- Power point presentation
- Group discussions
- Role plays
- Videos
- Review sessions
- Field excursion (optional)

Time: 30 Minutes

3.1 Background

Kenya is located between latitude 4°21' North and 4°28' South and between longitudes 34° and 42° East. The country covers a land area of 569,137 km^2 and is almost horizontally bisected by the equator and vertically by longitude 38° East (RoK, 1997). Kenya has a diversity of landforms ranging from glaciated mountains peaks under permanent snow cover through a flight of plateaus to the coastal plain. It is split by the Great Rift Valley into the eastern part dominated by Mt. Kenya and the Aberdare Ranges which rise to altitudes of 5200m and 4000m respectively. The western part of the country slopes down to Lake Victoria from the Mau ranges and Mt. Elgon (4300 m). The physical profile of the country makes it more susceptible to disasters.

3.2 Natural hazards in Kenya

Key facts on natural hazards typology and risk reduction in Kenya

i. Historically, disaster management in Kenya was not viewed as an integral part of development planning and disasters were responded to in an ad hoc manner when they occurred
ii. It was not until November/December 1997 when the devastating effects of El Nino floods hit most parts of the country, when the National Disaster Operation Centre was set up in January 1998
iii. According to the First National Water Resources Management Strategy, the El Nino induced floods of 1997-1998 caused some US $ 151.4 million in public property damage
iv. In June 1999, the Government of Kenya in collaboration with the United Nations Disaster Management Unit sought to develop disaster management strategies tailored to the Kenyan situation
v. Natural hazard include drought, floods earthquakes, volcanic eruptions, landslides cyclones, storms etc. These occur all over the world and are, on their own not harmful. However when these natural hazards interact with people, they are likely to cause damage of varying magnitude resulting in a disaster
vi. Disasters thus occur in Kenya when the natural hazards interact with vulnerable people, property, and

livelihoods causing varying damage depending on the level of vulnerability of the individual, group, property or livelihoods

vii. Disasters disrupt people's lives through displacements, deaths and injuries. They destruct livelihoods and drain years of economic gains and development

viii. The magnitude of a disaster depends on the characteristics, the probability and intensity of the hazard and the susceptibility of exposed elements based on the prevailing physical, social and environmental conditions

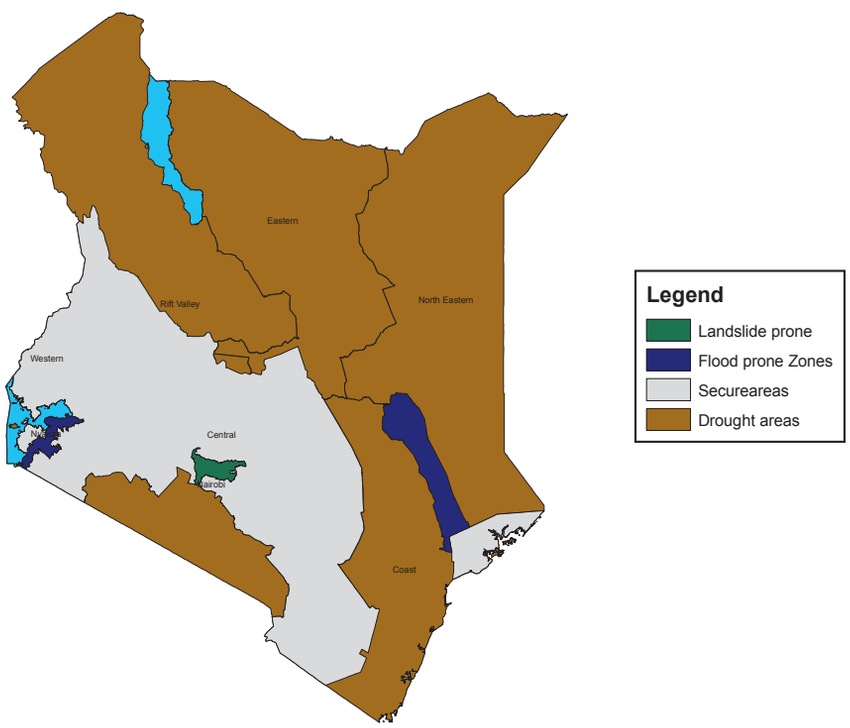
ix. The overall trend in hazard and disasters in Kenya. It is notable from this plot that, hazard and disaster occurrence has increased in recent years with key red flag years as 1961, 1997, 1998, 2006, 2007, 2008, 2009 and 2010

x. The hotspot seasons for disasters in Kenya have mainly been the short rains (October, November & December), dry season (January, February & March) and the long rains (April). The resultant effect of these disasters has been loss of human lives, injuries and loss of property. Apart from that, the disasters in Kenya have also been associated with widespread human displacement and disruption of livelihoods in the country.

xi. Kenya has experienced natural hazards and disasters since 1900 in all provinces. The ranking of provinces in terms of hazard occurrence is:

a. Rift Valley and Coast Provinces
b. Eastern, North Eastern and Nyanza Provinces
c. Western Province
d. Central Province and
e. Nairobi Province

Figure 3.1: Map of Kenya showing hazard hot spots



Adapted from Kenya National Disaster Profile by RCMRD

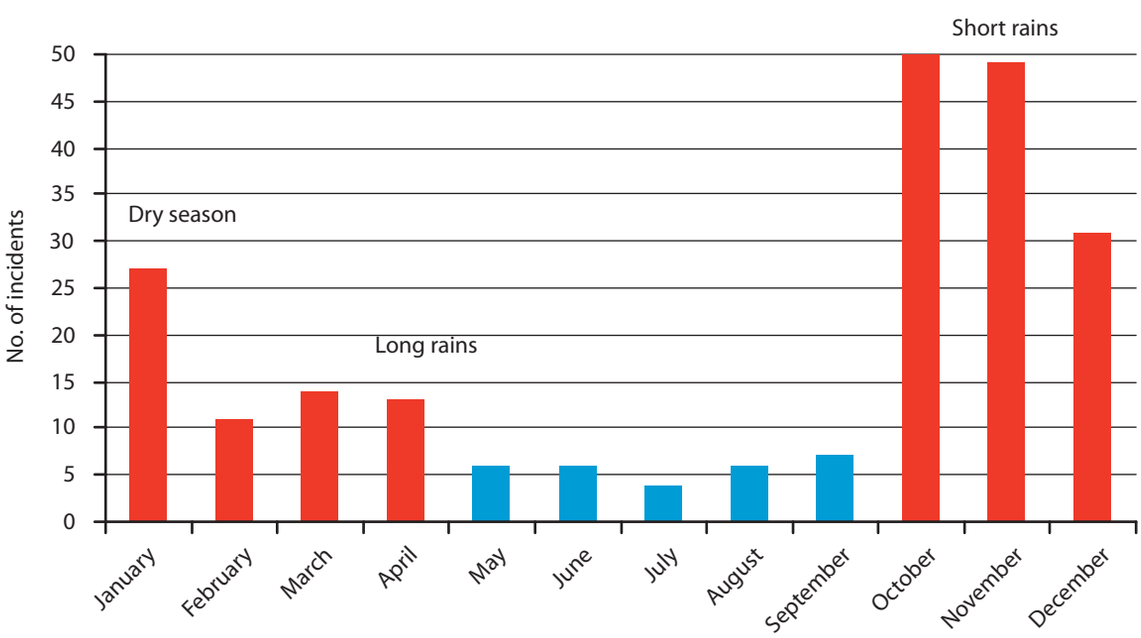
The classification of hazards in Kenya is dominated by natural hazards (53%). The key natural hazard hotspot districts in Kenya include Busia, Tana River, Garissa, Nairobi, Kisumu, Machakos, Mandera, Kajiado and Muranga.

Table 3.1: Recent history of natural disasters in Kenya

Year	Type of Natural Disaster	Area of Coverage	No. of People Affected
2004	Drought	Widespread	2-3 Million
2004	Landslides	Nyeri, Othaya, Kihuri	5 deaths
2002	Landslides	Meru Central, Muranga, Nandi	2,000
2002	Floods	Nyanza, Busia, Tana river basin	150,000
1999/2000	Drought	Widespread	4.4 million
1997/1998	El Nino Flood	Widespread	1.5 million
1995/96	Drought	Widespread	1.41 million
1991/92	Drought	Arid and semi-Arid districts of NE, Rift Valley, Eastern and Coast	1.5 million
1985	Floods	Nyanza and Western	10,000
1983/84	Drought	Widespread	200,000
1982	Floods	Nyanza	4,000
1980	Drought	Widespread	40,000
1977	Drought	Widespread	20,000
1975	Drought	Widespread	16,000

Source: Republic of Kenya (2004), National Policy on Disaster Management (Revised Draft) p4, Nairobi, Kenya.

Figure 3.2: The red flag seasons for natural disasters in Kenya

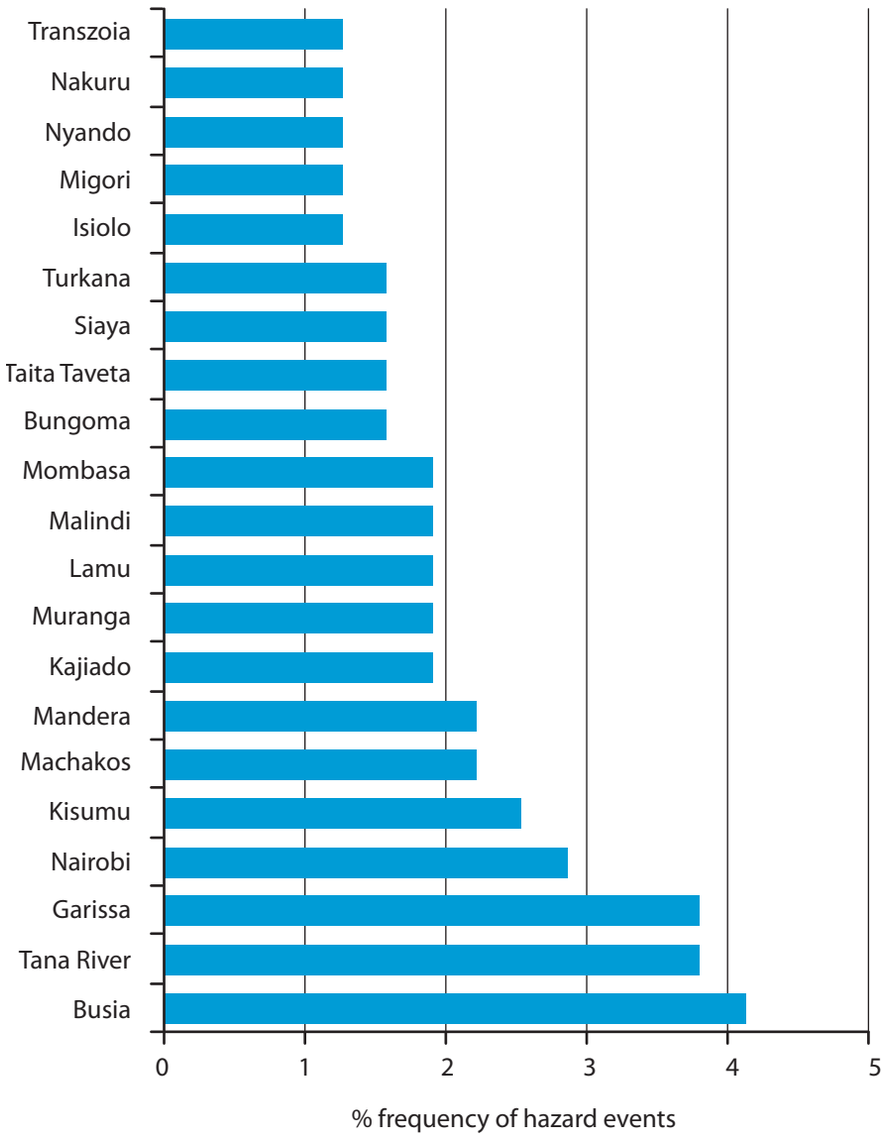


3.3 Disaster risk reduction in Kenya: Institutional and legal frameworks

The current policy framework for disaster management in Kenya consists of a wide range of instruments including the following:

i. National Disaster Management Policy
ii. National Disaster Management Legal Frameworks

Figure 3.3: Frequency of hazard events in Kenya



Source: UNDP, Kenya national disaster profile 2009

iii. National Disaster Management Institutions
iv. National Disaster Risk Reduction Strategy (2006-2016)
v. National Disaster Response Plan

3.3.1 National disaster management policy

Kenya government has recognized the importance of reducing disaster risk and has embarked on a comprehensive strategy to embrace disaster management in support of sustainable development. A draft disaster management policy has been created waiting to be tabled in parliament to strengthen strategies regarding actions to be taken before, during and after disasters. The draft policy has adopted a multi sectoral and multi disciplinary approach by incorporating key government organizations, private sector, civil society, NGOs, International organizations and the local community. The draft creates a National Disaster Management Authority provide leadership and coordinate in disaster management. To harmonize disaster management approach the draft recognizes other relevant Acts such as Kenya Red Cross Society Act, Water Act, and EMCA among others. Already there are

District Disaster committees operating in all districts in Kenya (GoK, 2002).

Kenya's disaster policy also recognizes the need to incorporate disaster risk reduction into development plans such as Poverty Reduction Strategy Paper (PRSP), Vision 2030 and sectoral development plans. The disaster draft also acknowledges the need to understand risk as key to effective disaster management. Disaster impacts largely depend on the characteristics, probability and intensity of a hazard as well as the susceptibility of the elements exposed to the risk based on physical, social, economic and environmental conditions (UNISDR, 2005).

The PRSP reflects the country's initiative towards long term disaster risk reduction in Kenya. Besides, the PRSP is linked to the Medium term expenditure framework (MTEF) which reallocates expenditure to priority sectors through consultations with the civil society (GoK, 2006). In addition, the public sector reforms and increased devolution of resources to grassroots will be critical to combat poverty and disaster vulnerabilities. However, more effort is required to coordinate the activities and align them to the Hyogo framework of action in support of sustainable development.

The goal of the policy is to ensure a safer, resilient and more sustainable Kenyan Society through the following objectives:

1. To establish a policy/legal and institutional framework for management of disasters, including promotion of a culture of safety and for building the capacity for disaster risk reduction at all levels
2. To ensure that institutions and activities for disaster management are coordinated, focused to foster participatory partnerships between the Government and other stakeholders at international, regional, sub-regional, national and local levels
3. To promote linkages between disaster management and sustainable development for reduction of vulnerability to hazards and disasters
4. To mobilize resources, including establishment of specific funds for disaster risk reduction strategies and programmers

3.3.2 National disaster risk reduction legal frameworks

The government has adopted a series of laws on disaster risk reduction. It has created a draft policy awaiting parliament to pass legislation. The draft envisions creation of the National Disaster Management Authority (NADMA) under the Office of the President. The Authority would be charges with several advisory and coordination tasks; it would also focus on efforts to reduce the impact of disasters on the country's economy and safety of its citizens. There are a range of legal frameworks relevant for disaster management in Kenya.

Assignment:

List the key Acts of parliament which support disaster risk reduction activities in Kenya.

Answer: The following legislation support disaster risk reduction in Kenya

1. Environment Management and Coordination Act (EMCA) of 1999
2. The Kenya Red Cross Society Act Cap 256
3. The Water Act Cap 372
4. Grass Fire Act Cap 327
5. Petroleum Act Cap 116
6. The Explosives Act Cap 115
7. St. John Ambulance of Kenya Act Cap 259
8. Factories and Other Places of Work Act Cap 514

Paired perspectives in disaster reduction approach

Two countries respond to the question of political commitment in disaster risk reduction.

Country A: A highly disaster prone country with considerable technical, material and financial resources and with strong political aspirations to modernize. Disaster mitigation is not a priority except in times of disaster. 'With many pressing requirements related to health, education, development, defence etc., disaster mitigation must be given diminished attention. We do not think that an easy recipe exists to overcome these obstacles'.

Country B: A highly disaster prone country with few technical, material and financial resources and much greater demands to realize strong political aspirations to develop. "It has been possible for the Government to institutionalize the concept of disaster management and also to generate momentum at the grassroots level self-reliance for coping with with and responding to disaster".

Source: ISDR,2001

9. The Local Authorities Act Cap 265
10. The Chiefs Act related to disaster Cap 128
11. The Public Health Act Cap 242
12. The Pharmacy and Poisons Act Cap 244
13. The Medical Practitioners and Dentists Board Cap 253
14. The Kenya Ports Authority Act Cap 391
15. The Civil Aviation Authority Act Cap 394
16. The Transport and Licensing Board Act Cap 404
17. The Animal Disease Act Cap 364
18. The Kenya Railways Act Cap 354
19. The Forest Act Cap 385
20. The Agricultural Act Cap 318
21. The Kenya Bureau of Standards Act
22. The National Cereals Board and Produce Act Cap 388
23. The Exchequer and Audit (Strategic Grain Reserve)
24. Trust Fund) Regulations 2000
25. The Police Act Cap 84
26. The Armed Forces Act Cap 199
27. The Administration Police Act Cap 85
28. The KWS Act Cap 376
29. Insurance Act Cap 1984
30. The NYS Act Cap 208
31. Petroleum Act Cap 116
32. Pharmacy and Poisons Act Cap 244
33. Police Act Cap 84
34. Public Health Act Cap 242
35. St. John Ambulance of Kenya Act Cap 259
36. The Explosives Act Cap 115
37. Transport and Licensing Board Act Cap 404
38. Trust Fund) Regulations 2000
39. Water Act Cap 372
40. Wildlife Act Cap 376

3.3.3 National disaster risk reduction institutional arrangements

Kenya has established a wide range of disaster management institutions Table 2 provides a summary of the key disaster management institutions in Kenya.

Assignment:

Identify key institutions in Kenya involved in disaster risk reduction related tasks and their role.

Answer: The following table are relevant institutions involved in disaster risk reduction related tasks in Kenya

3.3.4 National disaster risk reduction strategy (2006-2016)

The Strategy has the following goals:

i. Provide the legal and policy framework for disaster management
ii. Mandate and support a focal point to serve as the Nation's centre for emergency management information and expertise

Institution	Roles
The National Disaster Operations Centre (NDOC)	Overall coordination and control of the disaster response effort The command centre for all communications and information relating to response operation
Ministry of Provincial Administration and Internal Security	Responsible for coordination of disaster response Provide policy directive in National emergencies
Ministry of State for Special Programmes	Responsible for coordination of disaster risk reduction Provide policy directive in National emergencies
Other Sectoral Ministries	The Ministries will be required to mainstream disaster management into their sectoral activities, and will appoint disaster liaison focal point at the National level. The relevant Departmental Heads at the District level will participate in the District Disaster Management Committees. They will provide technical support and capacity-building to community-level disaster management structures. The sectoral ministries will play the leading role for those Disasters that are specific to their functions.
Department of Geology	Seismological monitoring
The Police Department (Traffic, GSU, AP)	Maintenance of law and order situation in and around the incidence scene
The Fire Brigade	Search and Rescue of trapped persons
The National Youth Service	Provide personnel and equipment to assist for quick and effective search and rescue coverage, protection and operation in case of any disaster
Kenya Meteorological Department	Provide Early warnings , hazards alerts and weather forecasts services before and during response operations
Kenya Power and Lighting Company (KPLC)	Provision of temporary power supply at the place of major incident or disaster

iii. Reduce loss of life, livelihoods and property
iv. Establish a Focal Point to provide information and advice to individuals, local governments, line ministries and parastatals in support of good risk management decision making
v. Minimize suffering and disruptions caused by disasters
vi. Improve the built environment
vii. Reduce the negative impacts of climate change

The government envisages the Authority will enhance the establishment of a disaster risk reduction national system that harmonizes the sub-national and national levels, and designates specific responsibilities for prevention, mitigation, preparedness, response, early recovery and reconstruction to different entities.

4. Module 3: Drought Hazard In Kenya

4.1 Learning objectives

At the end of the training the participants should be able to;

- Define and distinguish different types of droughts
- Identify spatial and temporal distribution of drought in Kenya
- Understand the causes of drought in Kenya
- Identify and predict likely impacts of drought
- Identify and apply drought hazard mitigation measures

Duration: 45 Minutes

4.1.1 Understanding "drought"

The climate and weather systems of the earth are constantly changing. As part of these dynamic processes, extremes of temperature, rainfall, and air movement will naturally occur. Periods of unusual dryness, i.e. droughts are therefore a normal feature of climate and weather systems in all countries. While droughts may be regarded as unusual in that they do not occur all the time, or in some areas for most of the time, drought should not be regarded as being ''abnormal" and, in fact, should be planted for in all countries. Drought is notoriously difficult to difficult to define and different definitions abound. Nevertheless, it is important that those involved in drought preparedness, mitigation, and rehabilitation activities share a common understanding of the ways in which drought may be define and the assumptions and constraints involved in using particular definitions.

A generally accepted definition of drought is a **temporary** reduction in water or moisture availability **significantly** below the **normal** or expected **amount (norm)** for a specified period.

1. The reduction is **temporary** (if the reduction were permanent then terms such as "dry" and "arid" would be more appropriate)
2. The reduction is **significant**
3. The reduction is define in relation to a "**norm**" i.e. normal expectation
4. The **period** taken as the basis for the norm is specified

How the "norm" is defined is of critical importance. Assumptions 3 and 4 therefore, require more detailed clarification. The "norm" may be defined either:

- **Technically** – a reduction of water availability might qualify as a "drought" when it falls below about 80% of the average availability over the preceding 20 years. However, the period selected as the basis for estimating the average may prove misleading
- **Culturally** – in terms of level of water availability the society has come to expect. Thus, after a run of ten years with above average rainfall a society may have become used to the wetter state and perceive the first year of average rainfall as a drought

Under system established by the World Meteorological Office (WMO) a 30 year international meteorological standard is used as a base period. Until 1991 the 30 year based period covered the years 1931-60. For the Sahel this included the predominantly wet years of the 1950s and early 1960s. During 12991 the international base period was changed to cover the period 1961-90. So far as the Sahel is

concerned, this includes virtually all the declining rainfall periods since the late 1960s. Thus, an agricultural planner utilizing the internationally established methods of estimating "normal" rainfall in relation to a particular project area in 1992 would find a much drier "norm" than if he/she had referred to the data in 1990. What might previously have been considered a drought year in 1960 might be considered an average year in 1992.

4.2 Background and distribution of drought in Kenya

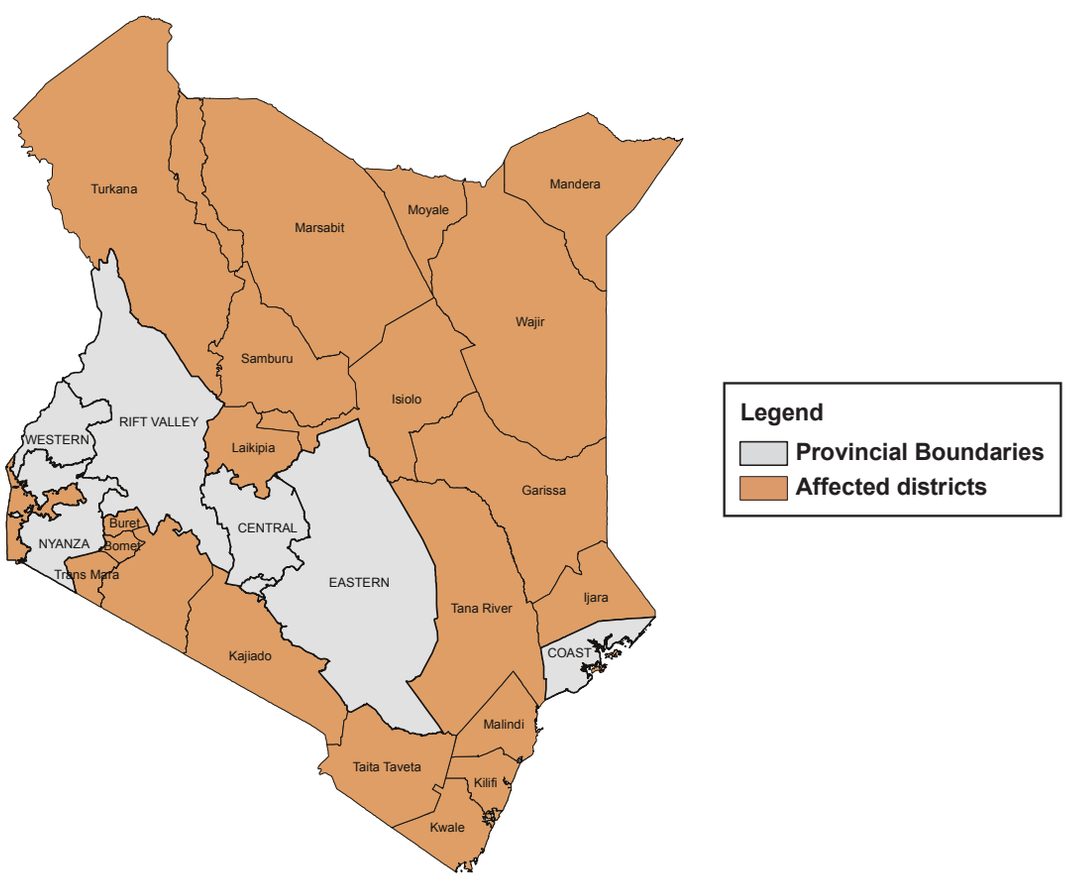
Drought affects mostly Eastern, Coast, North Eastern and parts of Rift Valley, Provinces of Kenya. The specific districts include Baringo, Laikipia, Turkana, Samburu, Narok and Kajiado in Rift Valley, Marsabit and Isiolo in Eastern province, Mandera, Garissa and Wajir in North Eastern and Tana River, Kilifi, Kwale and Taita-taveta in Coast Province. Most of these districts experience dry weather conditions causing pressure on the existing pastures and water resources on which the communities depend for survival.

The ASAL districts in Kenya are categorized as follows. 11 districts are classified as arid, 19 as semi arid and 6 as those with high annual rainfall but with "pockets" arid and semi-arid conditions. Figure 1.3 shows areas most affected by drought in Kenya.

Assignments:

i. Give a chronology of drought incidences in Kenya since 1980
ii. Choose a drought that you are personally familiar with and briefly describe it using each of the key assumptions described above

Figure: 4.1: RELIEF WEB (23rd June 2004); Districts Affected by drought in Kenya



Adapted from Kenya National Disaster Profile by RCMRD

Table 4.1: ASAL districts characterized by aridity level

Category	% Total ASAL	District
A. 100% ASAL	62%	Turkana, Moyale, Marsabit, Isiolo, Wajir, Mandera, Garissa, Ijara,
B. 85-100% ASAL	25%	Kitui, Makueni, Tanariver, Taita Taveta, Samburu.
C. 50-85% ASAL	8%	Machakos, Mbeere, Tharaka, Laikipia, West Pokot, Kwale, Kilifi, Baringo, Meru North
D.30-50% ASAL	3%	Lamu, Narok, Malindi, Keiyo, Marakwet,
E. 10-25% ASAL	2%	Nyeri (Kyeni), Rachuonyo, Suba, Kuria, Thika, Koibatek.

Republic of Kenya, National Policy for the Sustainable development of ASALs of Kenya.4th Draft, p 19, Nairobi Kenya

4.3 Types of droughts

It is conventional practice to distinguish between three different types of drought, namely meteorological, hydrological and agricultural. Particularly in the case of meteorological and agricultural droughts, these types are frequently, but wrongly, seen as being synonymous.

i. Meteorological drought

Meteorological drought describes a situation where there is a reduction in rainfall for a specified period day, month, season, or year) below a specified amount-usually defined as some proportion of the long term average for the specified time period. It s definition involves only precipitation statistics. It is a simple absence or deficit of rainfall from the normal. It is the least severe form of drought and is often identified by sunny days and hot weather. All the other types of droughts are driven by meteorological drought.

ii. Hydrological drought

Hydrological drought often leads to reduction of natural stream flows or ground water levels (streams, rivers, lakes, acquirers), plus stored water supplies. The main impact is on water resource systems.

iii. Agricultural drought

This form of drought occurs when moisture level in soil is insufficient to maintain average crop yields. Initial consequences are in the reduced seasonal output of crops and other related production. An extreme agricultural drought can lead to a famine, which is a prolonged shortage of food in a restricted region causing widespread disease and death from starvation. Agricultural drought is the impact of meteorological and/or hydrological droughts on crop yields. Crops have particular temperature, moisture and nutrient requirements during their growth cycle in order to achieve optimum growth. If moisture availability falls below the required amount during the growth cycle then crop growth will be impaired and yields reduced.

iv. Socio-economic drought

Socio-economic drought correlates the supply and demand of goods and services with the three above-mentioned types of drought. When the supply of some goods or services such as water and electricity are weather dependant then drought may cause shortages in supply of these economic goods.

4.4 Parameters of drought severity

Drought severity is determined by the following variables:

- Rainfall level
- Rainfall deficient (mm)
- Deviation from an average rainfall value
- Duration of the dry period

4.5 Causes of drought

When discussing the causes of drought it is helpful to distinguish between short

drought episodes lasting 1-3 years and long dry regimes of predominantly subnormal rainfall spanning about a decade or more and which may, include several intense drought episodes.

The proximate or immediate cause of a rainfall shortage may be due to one or more factors including an absence of available moisture in the atmosphere; large scale subsidence (downward movement of air within the atmosphere) which suppresses convective activity; and the absence or non-arrival of rain-bearing systems. Changes in such factors involve changes in weather systems on many spatial scales ranging from local to regional to global. While it may be possible to indicate the immediate cause of a meteorological drought occurring in any particular location, it is often not possible to indicate the underlying cause. Short term episodes can often be linked to global scale fluctuations in the atmosphere and oceans elsewhere in the world.

Other causes include:

i. Short term periodic fluctuations in rainfall levels
ii. Long term climatic changes
iii. Desertification caused by loss of vegetation
iv. Subsequent land erosion caused by combination of drought overgrazing and poor land management.
v. Deforestation
vi. Improper land use
vii. Extreme climatic events

4.6 Impact of drought

Of all natural hazards, droughts are potentially those having the greatest economic impact and affecting the greatest number of people. Earthquakes and cyclones may be of enormous physical intensity but are invariably of short duration and geographically limited. By contrast droughts affect large geographical areas, often covering countries or parts of continents and may last for several months and, in some cases, several years.

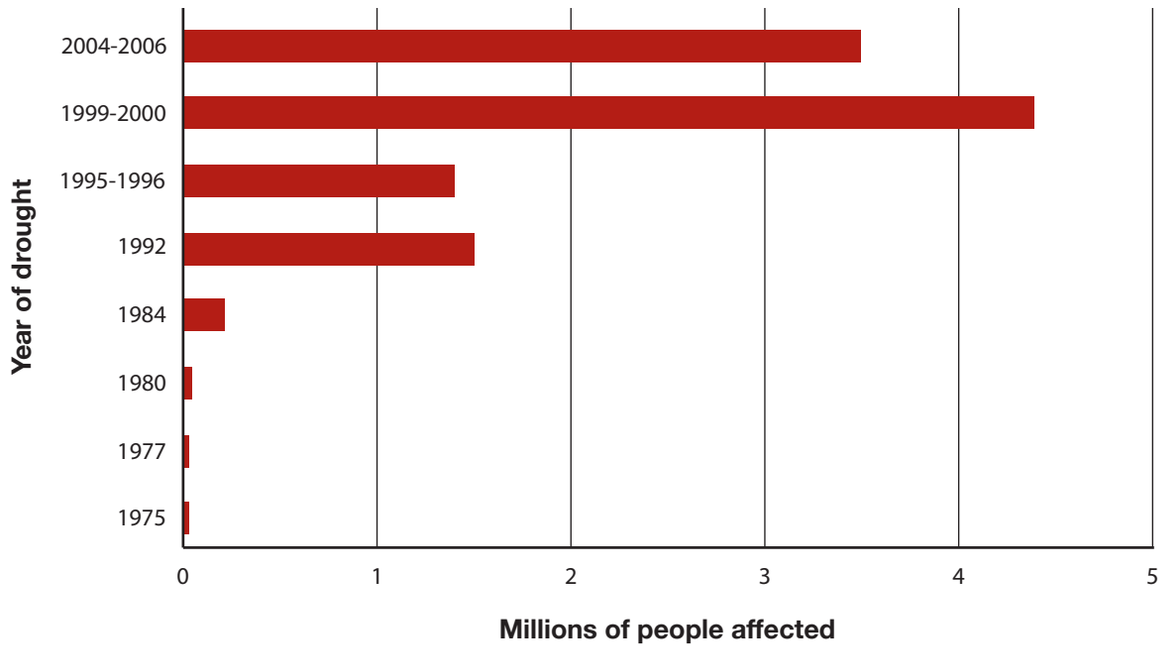
Of the main natural disasters, droughts are unique in terms of the length of time between the first indications from, for example, rainfall monitoring/that a drought is developing and the point at which it begins to impact significantly upon the population of the affected area. The length of such “warning time” varies significantly between societies. In many countries the warning time is on the order of several months. In others, for instance those with a high proportion of landless agricultural laborers, the warning time may be much less, perhaps only a few weeks. Whatever the period, a warning time allows for a potential response to mitigate the impacts of the drought before they become significant. In the case of countries where the lead time is on the order of months there is, potentially at least, sufficient time for relief assistance, including food aid, from the international community to be mobilized. It has become possible to prevent excess mortality resulting from food shortages caused by drought alone.

Thus, by virtue of modern meteorological monitoring and telecommunication systems it has become possible to prevent excess mortality resulting from food shortages caused by drought alone.

Assignment:

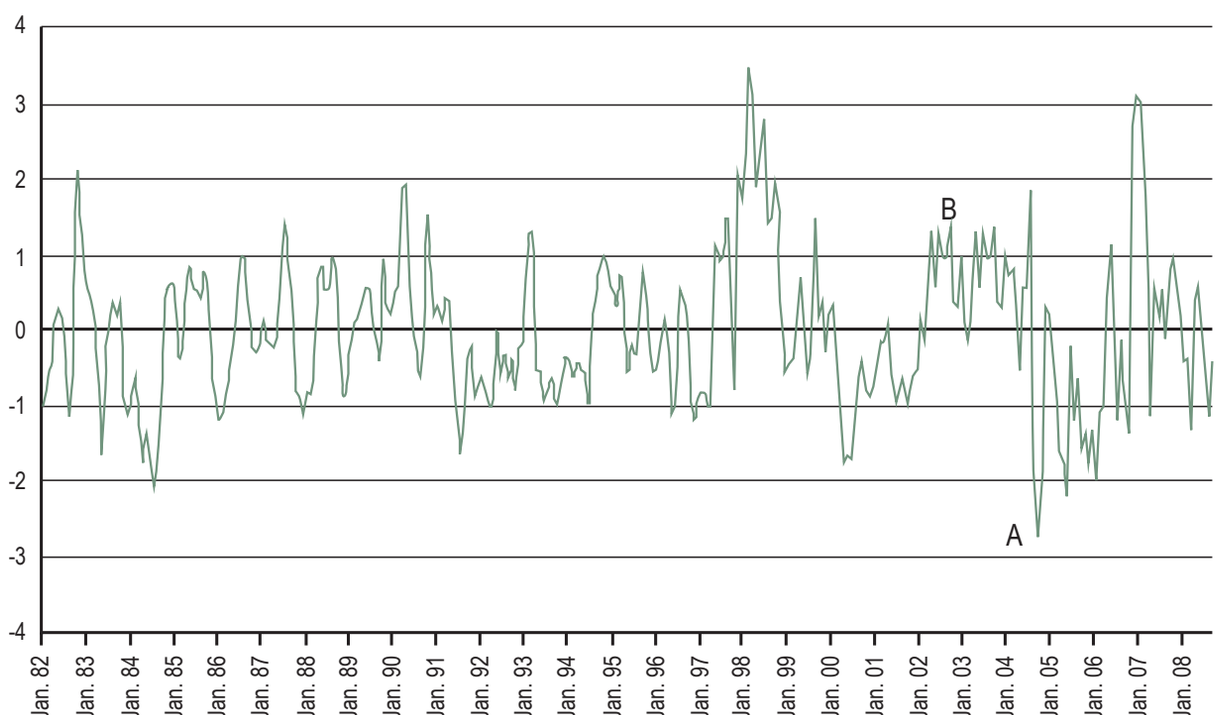
Discuss the main short-term and long-term social and economic impact of drought in Kenya

Figure 4.2: People affected by drought



(Source: Kenya atlas of the changing environment 2009)

Figure 4.3: NDVI anomalies computed for the whole country using NOAA NDVI from 1982-Sep 2008 to determine drought severity. Years in which drought is persistent is shown by troughs below normal, which was the zero axis of NDVI anomalies. Critical drought years in the country were 1984, 2000 and 2005-06 among others. SPOT vgt NDVI are used to illustrate the vegetation condition over the country during a drought year (a) and good year (b)



(Source: Kenya atlas of the changing environment 2009)

Answer: Long term impacts of drought

- Loss of livelihoods and paralyzed economic activities such as agriculture, pastoralism, power generation, etc.
- Poor health leading to vulnerability to diseases
- Deaths especially for the children and the aged
- General poverty
- Overall dependence on relief supplies from the Government of Kenya and World Food Programme among other donors.
- Increased conflicts due to
  - Diminished water and food resources
  - Political conflicts
  - Invasion by other communities from the neighborhood

Short term economic and social impacts of drought in Kenya

- Migration and displacement of families into areas with food supplies or relief foods
- Malnutrition causing ill-health
- Price hikes for commodities like cereals and food products while prices of livestock go lower because they are emaciated and unhealthy
- Lack of social amenities like water, food and sanitation services
- Livestock diseases like foot and mouth, lumpy skin disease and black quarter tend to increase during the drought seasons
- Low yields or no yields from agricultural activities due to low moisture content in the soil

4.7 Drought hazard assessment and mapping

Rainfall maps showing areas of desert conditions, semi arid and arid climatic conditions as well as soil erosion are used to depict drought hazard assessment.

4.8 Drought onset, monitoring and early warning

- Drought is a slow onset natural disaster which can take long period to detect. Early warning is by monitoring rainfall levels, river, well or reservoir levels
- Onset of severe drought causes death of livestock, rise in infant mortality and migration. Surveillance of these indicators should be monitored to regularly

Monitoring drought

Kenya has carried out extensive hazard mapping of drought through the Kenya Meteorological Department which has identified the key areas likely to experience drought. This information is available to all, including the academia, stakeholders and development partners. Kenya is also hosting the IGAD Climate Predictions and Applications Centre (ICPAC), previously known as the Drought Monitoring Centre (DMC). ICPAC was established in 1989 by the member countries through WMO and UNDP. The IGAD Climate Prediction and Applications center in conjunction with Kenya Meteorological Department (KMD) and the Office of the President carries out capacity assessments for institutions on the ground and sets up measures to reduce loss of life. It also issues warnings of when droughts are likely to occur, their duration and the areas to be affected.

ICPAC was established in 1989 by the member countries through WMO and UNDP and has a membership of 10 countries and funding mainly from IGAD, USAID, WMO and NOAA.

4.9 Elements most risk to drought hazard

- Crops and forest
- Economic activities dependent on continuous water supply

- Entire human settlement if drought is prolonged (leads to migration)

4.10 Drought mitigation, minimization and risk reduction strategies

Mitigation means taking actions to reduce the effects of drought before it occurs. The term mitigation applies to a wide range of short- and long-term activities, programs, policies and protection measures that might be implemented in advance of drought or in its early stages, to reduce the adverse effects on people and their livelihoods. It can be implemented as physical structures, like constructing all weather roads, grain storage facilities, or it can be procedural, like standard techniques for incorporating hazard assessment in land-use planning.

The most critical part of implementing mitigation is the full understanding of:

- The nature of the threat, in this case drought and
- The effects drought hazards are likely to cause. The damages depend on what is present in the region: the people, their sources of livelihood and infrastructure. Each area is different

4.11 Aims of drought mitigation

The main aim of mitigation is saving life and reducing economic disruption. A mitigation measure might aim towards **reducing the hazard or reducing vulnerability to that hazard**. Protection against threats can be achieved by removing the causes of the threat, (reducing the hazard) or by reducing the effects of the threat if it occurs (reducing the vulnerability of elements at risk). However, in the case of drought, it is impossible to prevent the actual meteorological process from occurring. The focus of mitigation policies against drought hazards is primarily on reducing the vulnerability of the elements and activities that are likely to be affected.

The primary aim is to reduce loss of livelihoods and the risk of death to the population. The worst effects of any drought are the deaths caused by drought-triggered famine. The scale of droughts and the number of people it affects (loss of livelihoods, famine, deaths) are the primary justifications for mitigation. Understanding the way that people can become vulnerable to drought impacts, drought-triggered famines and deaths, is a prerequisite for reducing drought impacts.

Stages of drought mitigation and risk reduction

Because droughts are a normal part of virtually any climate, it is important to develop plans to reduce their impacts. Drought management planning can be done at any level of government, from the national, provincial, district, divisional to community levels.

Drought management encompasses all aspects of planning for and responding to drought, (Figure 4.4) including both pre- and post-drought activities. It refers to the management of both the risks and the consequences of droughts. Drought management should be proactive so that mitigation can reduce drought impacts, and so relief and recovery decisions are made in a timely, coordinated, and effective manner during a drought. This is in contrast to drought crisis management where there is no prior planning before a drought event, and decisions are made in a reactive manner during a drought event, which sometimes lead to ineffective, poorly coordinated, and untimely initiatives (Knutson et al. 1998).

Drought mitigation includes preparedness and long-term risk reduction measures and post-disaster response. This includes

the process of planning and implementing measures to reduce the risks associated with known natural and man-made 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).

Drought preparedness refers to pre-drought activities designed to increase the level of readiness or improve operational capabilities to forecast, take precautionary measures and respond to a drought. Preparedness is a mitigation action. Drought preparedness comprises policies and standards, research, education and training, information systems (early warning/monitoring systems) and contingency plans.

Drought early warning/monitoring systems are information systems developed to study the nature of drought hazard, monitor its dynamics over time and possibly forecast its occurrence and magnitude. Drought monitoring systems make forecasts for the seasonal rainfall, its onset, expected amounts and geographical spread, and its end. Potential impacts on the agricultural sector and food security, as well as on other sectors are also forecasted and farmers are advised accordingly. Research on climate is also conducted by DMCN and is incorporated into the monitoring system.

Early warning and monitoring systems can also provide information systems on crop and livestock production and marketing, as well as on food security. An example is the USAID Famine Early Warning Systems Network (FEWS-NET). Based on these data, assessments to monitor indicators of food security are periodically made to arrive at monthly outlooks on agro-climatic conditions, crop production and pastoral food security. In addition, trends in prices of maize and livestock are also analysed. These applications have been found to be very effective assessments in producing information for early warning systems on food security (FEWS-NET 2002).

Identifying situations where combinations of risk factors coincide indicates the ***elements most at risk***. The elements most at risk are those that will suffer most from the effects of the hazard or will be least able to recover after the event. The number of elements likely to be affected by drought, together with their ***vulnerability*** to the drought will identify where mitigation is most effective.

Therefore, risk and vulnerability are integral parts of drought planning and monitoring.

Drought risk assessment is the process of estimating, for defined areas, the occurrence or the probabilities of the occurrence of drought and its impacts. The contributory factors of past droughts can be identified to highlight similar conditions elsewhere. **Impact assessment** is part of drought risk assessment. It is the process of examining the magnitude and distribution of impacts associated with drought.

Vulnerability implies both susceptibility to drought and lack of resources for rapid recovery. Impacts can be regarded as symptoms of vulnerability. Vulnerability assessment is therefore a crucial aspect of planning effective mitigation.

Drought vulnerability assessment provides a framework for identifying the social, economic, and environmental causes of drought impacts (Knutson et al. 1998). Drought vulnerability assessment produces information that helps to understand how a system is potentially affected by and responds to a drought event. It bridges the

gap between impact assessment and policy formulation by directing policy attention to underlying causes of vulnerability rather than to its result, the negative impacts, which follow triggering events such as drought (Ribot 1996). For example, the direct impact of drought may be crop loss. The underlying cause of this vulnerability, however, may be that the farmer did not use drought-resistant seeds, either because he did not believe in their usefulness; the costs were too high, or because of some commitment to cultural beliefs. Based on such findings, recommendations of mitigation measures can be made.

To reduce physical vulnerability weak elements may be protected or strengthened. To reduce the vulnerability of social institutions and economic activities, infrastructure may need to be modified or strengthened or institutional arrangements modified.

Preparedness involves the development and regular testing of warning systems (linked to forecasting systems) and plans of measures to be taken during a drought alert period to minimize potential loss of livelihoods.

A drought contingency plan is a document that identifies specific actions that are to be taken before, during (e.g. by organising and delivering timely and effective relief and assistance), and after a drought to mitigate some of the impacts and conflicts that result. It also specifies who implements what actions and who coordinates the whole process. Frequently these actions are triggered by a monitoring system. Any level of government down to the community level can develop and implement a drought contingency plan for its area.

Drought response measures are actions taken immediately before, during, or directly after a drought to reduce impacts and improve recovery. They can be already specified in the contingency plan. Response measures are an important part of drought preparedness but should only be one part of a more comprehensive mitigation strategy (Knutson et al. 1998).

Drought recovery measures are activities implemented to rehabilitate communities and individuals so that they can increasingly become independent and able (socially and economically) to undertake enterprises to stabilize their livelihoods. Such measures create or fortify the basis for the re-organization of the social and economic fabrics of a society, through the re-establishment of basic and suitable conditions for the re-launching of livelihoods. In addition, the aspect of the sustainability of recovery measures has to be considered.

Finally, as communities and people recover from drought, lessons learnt during the event should be incorporated into the monitoring systems and the contingency plan should be modified accordingly.

The figure 4.4 highlights the standard systematic chain of strategies for drought preparedness, response and mitigation. These strategies are configured in drought management programmes and projects such as the ALRMP.

Drought contingency planning

Contingency planning is a management tool used to prevent impact of drought hazards or better response for drought emergency. Is a forward planning process for the future in which drought scenarios are agreed, managerial and technical actions defined and potential response systems are put in place in order to prevent or better respond to drought. Certain scenarios and objectives are agreed on in advance.

Figure 4.4: Systematic drought management in Kenya

(Source: ALRMP 2009)

Steps in drought contingency planning:

i. Assess drought and its potential impacts on livelihoods/assets
ii. Prioritize/rank the impacts in order of severity
iii. For a rank, develop appropriate emergency plans and early warning system
iv. Ensure preparedness measures are in place

Content of drought contingency plan

A drought contingency report should be laid out in a systematic manner as shown below:

i. Title of contingency plan e.g. Contingency plan for drought in Turkana
ii. Background information of drought in Turkana)
iii. Introduction of the plan (Problem statement, objectives and justification)
iv. Drought intervention activities covering drought scenarios (pre-drought, during the drought and drought recovery/ response)
v. Collaborators/stakeholders
vi. Gender considerations
vii. Environmental considerations
viii. Monitoring and evaluation
ix. Sustainability
x. Budget
xi. Logical framework

Team work and collaboration in contingency planning

Different organizations and agencies with different mandate are involved in contingency planning. Transparency and inclusiveness leads to more preparedness

and better response. Coordinating contingency planning should be led by an organization which has a comparative advantage of drought management. The Government of Kenya takes the lead through the Arid Lands Management Project (ALRMP). Other organizations come in to support. A plan f action and integration with other programmes by other stakeholders is accomplished as illustrated in table 4.2.

4.12 Community participation

- Construction of check dams, reservoirs, wells, water tanks
- Planting and reforestation
- Changing cropping patterns
- Introducing water conservation policies
- Changing livestock management practices
- Development of alternative non-agricultural industries

Table 4.2: Illustration of contingency plan of action and integration with other programs and stakeholders

Activity	Specific Activity	Responsibility	Timeframe	Remarks
Herd management	Vaccination of 200,000 cattle in Turkana District	Veterinary department/officer	January 2010	
Water harvesting and conservation	Construct two water pans at Salama Village	Water department	January 2010	
Forestation	Establish five agro-forestry nurseries at Makutano village each of 5000 seedlings	German Agro Action	February 2010	
Agriculture	Provision of 10 tonnes of drought tolerant crops	Ministry of Agriculture	February 2010	
Security	Conduct five meetings on peace initiatives	Provincial administration	March 2010	

Table 4.3: Table illustrating scenarios in drought contingency plan

Scenarios	Predicted Impact	Proposed Intervention	Organizational Response
Scenario 1: Normal	Livestock and pastoralist indicators show no unusual fluctuations	Drought mitigation measures (institutional, engineering, societal, economic and planning measures) • Institutional and management measures • Construction of dams • Herd management(vaccination, destocking, etc) • Reduce deforestation • Use of improved fuel stoves to reduce deforestation • Introduction of drought tolerant crops • Population control • Education and training • Drought monitoring and EW	Information sharing, funding, coordination

contd. on next page

Scenarios	Predicted Impact	Proposed Intervention	Organizational Response
Scenario 2: Alert	Environmental and livestock stress indicators start to fluctuate outside the expected seasonal ranges	• Herd management • Transportation of fodder • Education and training • Drought monitoring and EW • Drought monitoring and EW	Information sharing, funding
Scenario 3: Alarm	Environmental and livestock stress indicators continue fluctuate/deteriorate outside expand situation extends beyond expected range. Population displacement occurs.	• Transportation of fodder • Livestock movement • Transportation of water and water • Water rationing • Transportation and warehousing of relief food • Drought monitoring and EW	Information sharing, funding
Scenario 4: Emergency	The environment and pastoralist population are in a state of emergency. Displacement of herders and their families continue. Large scale livestock mortality occurs. Pastoralist welfare/ livelihood indicators fall to near minimum.	• Herd management • Relief food distribution • Transportation of fodder • Water rationing • Energy rationing • Drought monitoring and EW • Primary health care • Peace building	Information sharing, funds

Group exercise:

Formulating drought mitigation and risk reduction in ASALs

Exercise: Participants are requested to

Read through the document: 'Planning against drought and famine in Turkana: A district Contingency Plan' by Jeremy Swift (1989) in 'Coping with drought in Kenya'. Downing T. E. et al. (Eds.) Lynne Rienner Publishers, London.

Propose and plan a drought mitigation and risk reduction strategy

Present their group-work.

Plenary discussion follows after.

Table 4.3: Illustration of water contingency plan

Activity	Normal/Alert/Alarm						Emergency						Recovery					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
8.1.1 Check water sources	X																	
8.1.2 conduct sensitization training on thrift water management																		
8.1.3 Rehabilitate critical water sources in areas of high concentration																		
8.1.4 purchase water browsers for ferrying water to isolated areas		X																
8.1.5 Repair broken down vehicles																		
8.2.1 Carry out routine maintenance and repairs of all the water sources affected by intensified usage.																		
8.2.2 Continue supplying water with bowsers to divisions with less or poorly performing water sources																		
8.3.1 Make follow-up on the conditions of operational water supply facilities																		
8.4.1 Develop reliable water resources at strategic areas for human and livestock																		

5. Module 4: Flood Hazard in Kenya

5.1 Learning Objectives

At the end of the training the participants should be able to;

- Define and distinguish different types of floods
- Identify the temporal and spatial flood distribution in Kenya
- Identify and predict likely impacts of floods
- Identify and understand flood hazard mitigation measures

Module duration: 30 Minutes

Training methods
- Power point presentation
- Group discussions
- Role plays
- Review sessions

5.2 Understanding "floods"

Floods occur in Kenya due to natural factors like flash floods, river floods and coastal floods. They may also occur due to human manipulation of watersheds, drainage basins and flood plains. For example, in some cases floods have occurred in the river basins even with normal rains because of excess surface water run-off occasioned by deforestation, land degradation upstream. Kenya is affected by floods following torrential rainfall. These force thousands of people living in the lowlands to move to higher grounds. The people affected are mostly in western and Nyanza provinces and in Tana River district. However slum dwellers in towns like Nairobi who have erected informal structures near rivers are not spared.

A **"flood"** is an unusual high-water state in which water overflows its natural or artificial banks onto normally dry adjacent land. Floods are normal and natural occurrences which we must adapt ourselves to live with at all times. Floods may happen gradually or very suddenly without any warning.

5.2.1 Types of floods

There are different types of floods namely:

i. Predictable regular floods
   - Lasts up to 3 months
   - Limited damage and displacement of population

ii. Flash flooding
   - Takes a few days
   - Rapid cresting with little warning
   - High velocity flood with potential to destroy infrastructure
   - Localized population displacement

iii. Urban flooding
   - Rapid onset coming with flash floods coming in urban rivers from saturation or blockage of urban drainage system
   - Localized population movement
   - Has potential for infrastructure damage

5.3 Areas affected by floods in Kenya

Most parts of the nation experience river floods which are slow onset and mostly predictable. However some parts experience more severe floods than others including most parts of Kano plains (Nyando district) and Nyatike (Migori district) in Nyanza province, Budalangi in Western province resulting from river Nzoia and the lower parts of Tana River. The specific areas that experience floods almost annually include:

1. Nyanza Province – Kano plains, Nyakach area, Rachuonyo and Migori
2. Western Province – Budalangi

3. Coast Province – Kilifi, Kwale and the Tana River Basin
4. North Eastern province – Garissa, Wajir, and Ijara
5. Urban Centres – Nairobi, Nakuru, Mombasa, Kisumu
6. Tana River district (the Lower parts)

5.4 Parameters of flood severity

Parameters of flood severity include:

- Area flooded (km²)
- Depth of height of flood
- Amount of mud deposited or held in suspension

5.5 Causes of floods

The causes of floods may vary from a rural area to an urban area but some of the major ones are:

- Heavy rainfall
- Deforestation of the catchment basin
- Heavy siltation of the river bed which reduces the water carrying capacity of the river way
- Landslides and mudflow by blocking the flow of the stream
- Blockage of urban drains
- Bursting of reservoirs as a result of dam failure

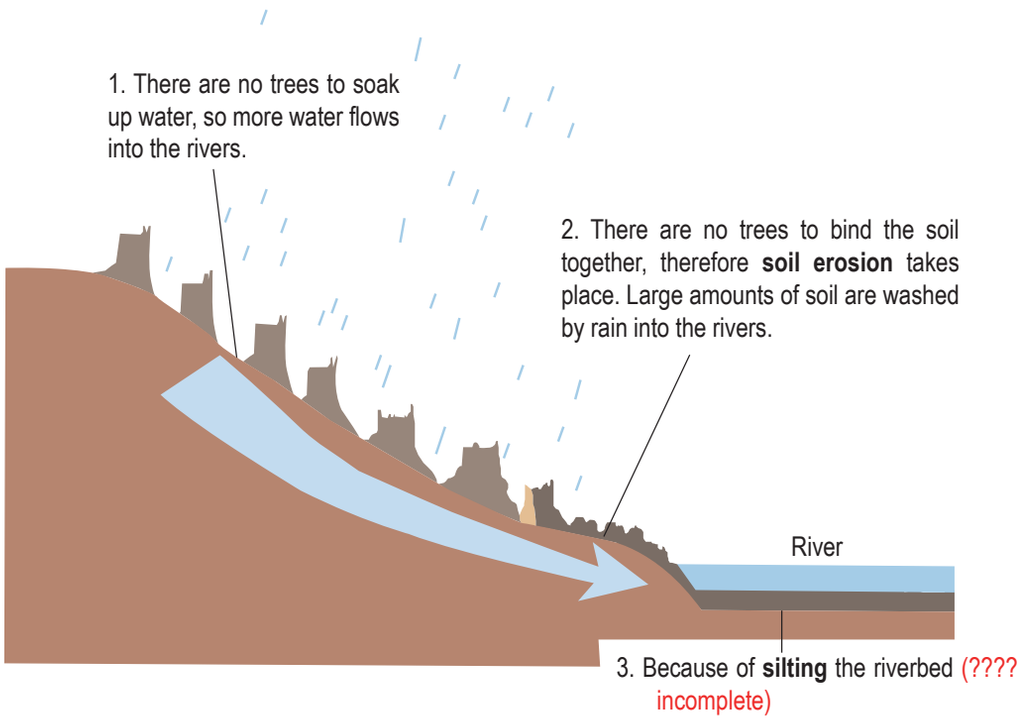
Fig: 5.1: Map of Kenya showing areas prone to flooding 2002-6

(Source: World Resources Institute 2006)

Illustration of causes of flood disaster in Budalang'i,western Kenya

Budalang'i floods are caused by heavy rainfall from the upstream areas such as Cherang'ani. The victims of the disasters would be suffering due to various vulnerabilities such as location of assets (physical), cultural, political, lack of knowledge, inadequate institutional capacity and lack of resources. These factors make people vulnerable. This would be most apparent when economic pressures force poor people in the Budalan'gi area live in dangerous locations such as flood plains. Vulnerability is linked to poverty but not always. In the flood plains wealthier inhabitants are better able to build houses that withstand floods or any other hazard. They can afford to raise the foundations of their houses above the usual flood level. They can afford to buy land elsewhere.

Figure 5.2: Causes of floods



(Source: Kenya atlas 2009)

- Failure of the flood protection dikes, sea walls, levees or dam failures
- Soil erosion generating material that clogs drainage system and inlets
- Inadequate street cleaning practice that clogs street inlets
- High tides may flood coastal areas, or seas be driven inland by windstorms.
- Tsunamis are caused by underwater earthquakes or eruptions

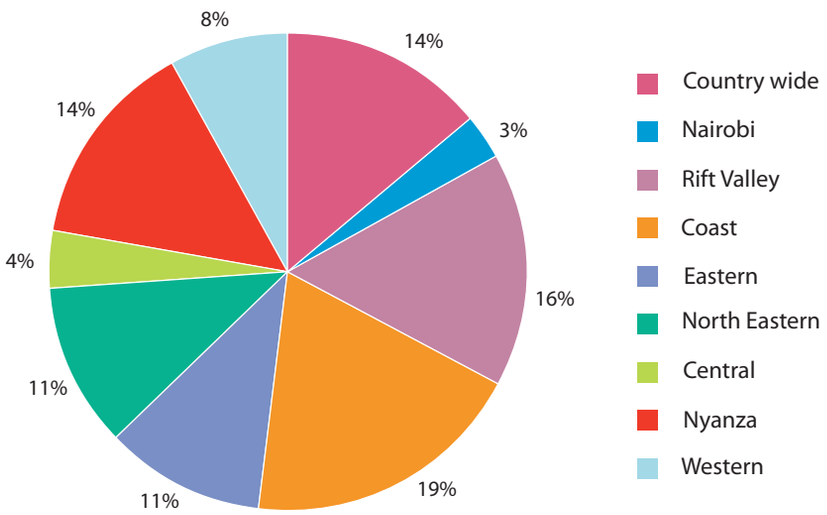
5.6 Mechanisms of flood destruction

Floods destroy through the following action:

- Inundation and flow of water with mechanical pressures of rapidly flowing water
- Currents of moving or turbulent water can knock down and drown people and animals in relatively shallow depths
- Debris carried by the water is also destructive and injurious
- Structures are damaged by undermining of foundations and abutments
- Mud, oil and other pollutants carried by the water is deposited and ruins crops and building contents
- Flooding destroys sewerage systems, pollutes water supplies and may spread disease

Figure 5.2 a, b, c: Countrywide flood profile

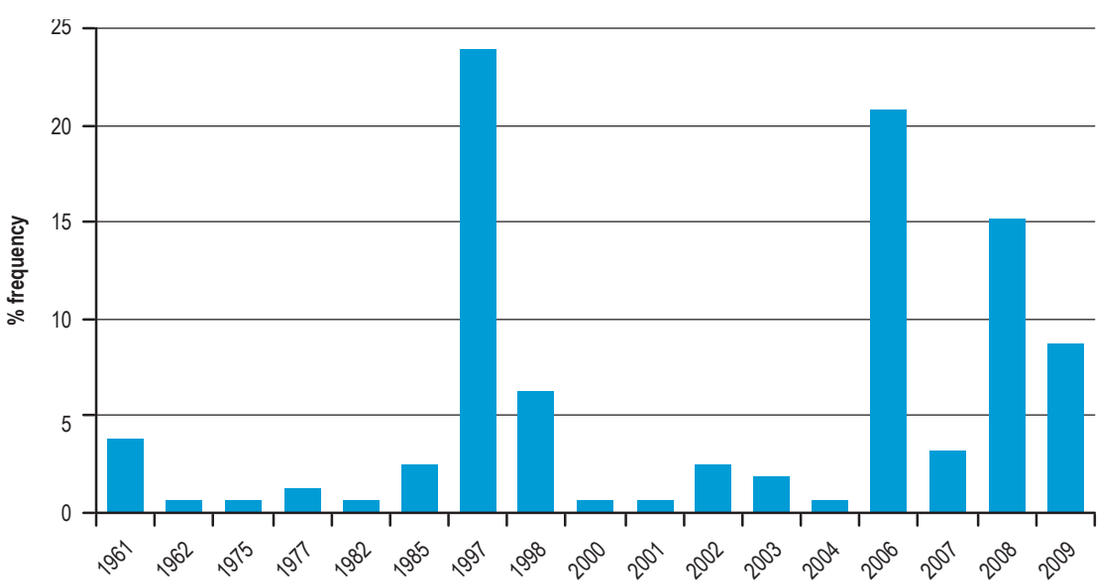
a. Geographic distribution



b. Number of flood incidents and deaths

Year	No. of Reported Flood Incidents	No. of Deaths
1977	2	100
1985	3	20
1997	16	309
1998	5	1508
2002	2	24
2006	21	84
2007	2	15
2008	19	22
2009	5	29

c. Historical trend (1900-2010)



(Source, Ministry of Special Programmes/UNISDR, 2010)

- Saturation of soils may cause landslides or ground failure

5.7 Economic and social impacts of floods on the regions affected

a. Structural damage to buildings, roads, rails, communication lines, and land in general causing massive erosion resulting in wide gullies that cannot be cultivated anymore
b. Deaths of people and animals from drowning and injuries from displaced boulders, falling buildings, trees and others
c. Possible outbreaks of diseases like malaria, cholera, dysentery etc due to presence of mosquitoes and contamination of water sources by the floodwaters
d. Contamination of wells and ground water which is the major source of drinking water by most rural communities
e. Loss of harvests and crops in farms, loss of food stocks, supplies and produce from farms

5.8 Floods hazard assessment and mapping

When dong flood assessment we use:

- Historical records which indicate flood return period
- Topographic mapping and height contouring around river systems
- Estimating hydrology and catchment area
- Precipitation records to estimate probability of load
- Topography and beach characteristics

5.9 Flood monitoring and early warning institutions

Flood forecasting and early warning in Kenya is mainly carried out by the Kenya Meteorological Department in conjunction with the Office of the President. Other institutions include the Ministry of Water and Irrigation and the Water Resources Management Authority (WRMA) which has regional offices around the country (Nairobi, Kakamega, Eldoret, Kitale, Siaya, Kisumu, Kericho, Kisii, Nakuru, Naivasha, Narok, Nanyuki, Kapenguria, Kabarnet, Lodwar, Machakos, Kibwezi, Kiambu, Kilifi, Embu, Meru, Muranga, Nyahururu, Kitui, Garissa, Isiolo, Marsabit and Mandera). The institutions monitor and map adverse weather events (heavy and scarce rains), report the occurrence of the events and assess the risk posed to lives, livelihoods, infrastructure and property. The following need to be monitored;

- Flooding may happen gradually, building up depth over several hours, or suddenly with the breach of retaining walls
- Heavy prolonged precipitation may warn of coming river flood or urban drainage overload
- High tides with high winds may indicate chance of coastal flooding some hours before it occurs
- Evacuation may be possible with suitable monitoring and warning system in place
- Tsunamis arrive hours or minutes after an earthquake

5.10 Elements most at risk to flood hazard

The following are the elements most at risk-affected most by floods or take long time to recover after floods:

- Buildings with shallow foundations or weak resistance to lateral loads or impact.
- Basements or underground buildings.
- Utilities: sewerage, power, water supply in flood prone areas
- Machinery and electronics including industry and communications equipment.
- Food stocks
- Cultural artifacts
- Confined/penned livestock and agriculture
- Fishing boats and other maritime industries

5.11 Mitigation prevention, minimization and risk reduction strategies

The following actions can be used in order to prevent:

Flood prevention

Strategies:

a. Mapping of flood prone areas
b. Land use control
c. Catchment conservation

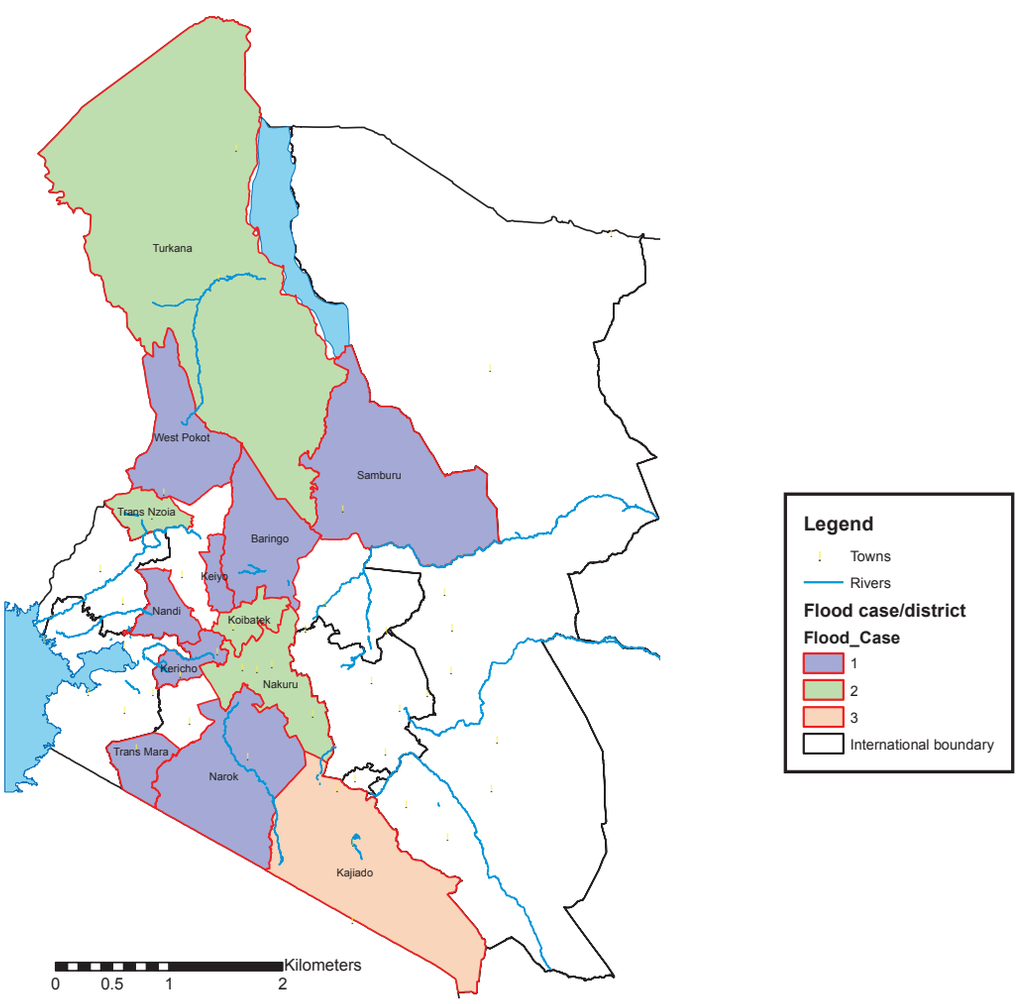
a. Mapping of the flood prone areas

This is a primary step involved in reducing the risk of the region. Historical records give the indication of the flood inundation areas and the period of occurrence and the extent of the coverage. Warning can be issued looking into the earlier marked heights of the water levels in case of potential threat. In the coastal areas the tide levels and the land characteristics will determine the submergence areas. Flood hazard mapping will give the proper indication of water flow during floods. Flood hotspot maps can be used in the regulation of development activities in vulnerable areas.

b. Land use control

Land use control can be used to reduce danger of life and property when waters inundate the floodplains and the coastal areas. The number of casualties is related to the population in the area at risk. In

Fig.5.4: Flood hazard map of Rift Valley



Adapted from Kenya National Disaster Profile by RCMRD

areas where people already have built their settlements, measures should be taken to relocate to better sites so as to reduce vulnerability. No major development should be permitted in the areas which are subjected to high flooding. Important facilities like hospitals, schools should be built in safe areas. In urban areas, water holding areas can be created like ponds, lakes or low-lying areas.

c. Catchment and wetland conservation

The risk of flood hazards is usually increased by removal of forests in catchment areas and transformation of wetland ecosystems especially along the river-ways where they serve as natural buffers against flood disaster.

Flood mitigation strategies

There are two ways to control floods;

1. Structural-physical measures aimed at keeping water away from people by use of physical means to control water such as embankments or dykes, drainage management, reservoir management or buildings in elevated areas
2. Non structural

1. Structural measures

Examples of low-cost structural measures for reducing flooding include the following:

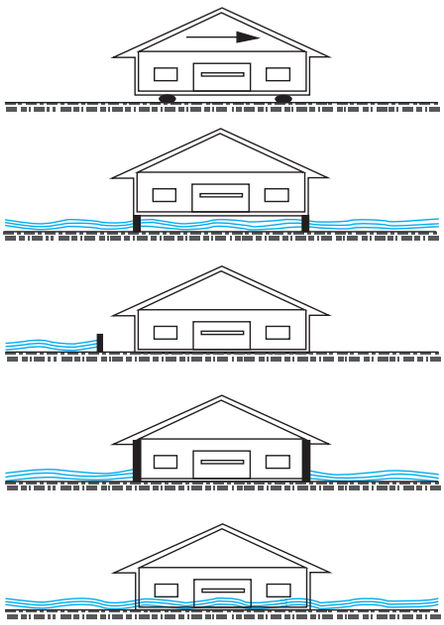
a. Flood diversion structures such as levees, embankments and dams. Dams can store water and can release water at a manageable rate. But failure of dams in earthquakes and operation of releasing the water can cause floods in the lower areas
b. Riverbank integrity through establishment of protective grass and bush covered land strips along streams and rivers
c. Protective land management such as contour plowing and grading
d. Disconnecting roofs from street drainage conduits, providing gravel beds below lawns, replacing concrete with permeable asphalt, regular removal of sediment deposited in the low lands
e. Construction site stabilization measures that reduces erosion and sedimentation (temporary seeding, mulching, geo-textile, silt fences, hay bales, sediment traps and storm drain inlet protection
f. Construction of engineered structures. This is necessary in the flood plains in order to ensure strengthening of structures to withstand flood forces and seepage. The buildings in flood prone areas should be constructed on an elevated area. If necessary build on stilts or platform
g. Flood Proofing. Flood Proofing reduces the risk of damage by using various measures that includes; the use of sand bags to keep flood water away, blocking or sealing of doors and windows of houses etc. Houses may be elevated by building on raised land. Buildings should be constructed away from water bodies
    - **Relocation:** Moving a building to high ground above flood level
    - **Elevation:** Raising a building so that flood waters will go under it
    - **Floodwalls:** Building a wall to keep flood water from reaching a building
    - **Dry flood proofing:** Making the walls of the building and the openings watertight
    - **Wet flood proofing:** Altering a building to minimize damage when flood waters enter

2. Non-structural measures

Include the following:

a. Local authorities can pass laws that restrict land use in flood plains thereby reducing the cost of flood damage
b. Flood forecasting and early warning-issued by relevant government departments such as metrological department or water and irrigation

Figure 5.5: Food proofing



Relocation:
Moving a building to high ground, above flood level

Elevation:
Raising a building so that flood waters will go under it

Floodwalls:
Building a wall to keep flood water from reaching a building

Dry floodproofing:
Making the walls of the building and the openings watertight

Wet floodproofing:
Altering a building to minimize damage whenflood waters enter

5.12 Community-based risk reduction measures

The majority of deaths and much of the destruction created by floods can be prevented by mitigation and preparedness measures. Where construction in flood-prone sites is necessary or cannot be avoided, houses can be constructed to be flood resistant using materials resistant to water damage and strong foundations. Awareness of water hazards can be reflected in living practices such as constructing elevated storage and sleeping areas. Crop cycles can be modified to avoid the flooding season, and flood-resistant crops can be introduced.

Communities can reduce the risk of personal harm by preparing flood evacuation plans which include the identification of evacuation routes and availability of boats or other appropriate transport and rescue equipment. Monitoring and warning systems at the local (and regional) level are also important components of a risk reduction strategy.

The following are recommended community-based risk reduction measures:

- Sedimentation clearance
- Dike construction
- Awareness of flood plain
- Houses constructed to be flood resistant (water-resistant materials, strong foundations)
- Farming practices to be flood-compatible
- Awareness of deforestation
- Living practices reflect awareness: storage and sleeping areas high off ground
- Flood evacuation preparedness, boats and rescue equipment

Assignment:

Outline measures and strategies a community living in flood areas should undertake before, during and after floods.

Answer:

1. *What to do in preparation for a flood disaster*

- Establish whether you live in a flood-prone area from your local authorities or the relevant ministry. Ask them whether your property is above or below the flood stage level and learn about the history of flooding for your local area
- Learn about flood warning signals if available and the weather forecasts and advisories
- If you live in a frequently flooded area, stockpile emergency building materials, such as plywood, plastic sheeting, lumber nails, hammer and saw, shovels and sandbags
- Plan and practice an evacuation route. Contact the local emergency management office for a copy of the community flood evacuation plan. This plan should include information on the safest routes to shelters. Individuals living in flash flood areas should have several alternative evacuation routes.
- Have disaster supplies on hand, such as flashlights, battery operated radio, extra batteries, first aid kit, emergency food and water, sturdy shoes, non-electric can opener, essential medicines, cash and credit cards
- Develop and emergency communication plan. In case family members are separated from one another during floods, have a plan for getting back together. Ask an out-of-community relative or friend to serve as the "family contact". Make sure everyone in the family knows the name, address and phone number of the contact person
- Teach all members how and when to turn off gas, and water. Teach children how and when to call police, fire department, and which radio station to tune on for emergency information

2. *What to do during a flood watch*

- Listen to a battery-operated radio for the latest storm information and be prepared to evacuate
- Fill bathtubs, sinks, and jugs with clean water in case water becomes contaminated
- Move valuable household possessions to the upper floors or to safe ground if time permits
- If you are instructed to do so by local authorities or other relevant agencies, turn off all utilities at the main switch and close the main gas valve

3. *What to do during a flood*

- If indoors, turn on battery-operated radio, get the latest information, and if told to leave, do so immediately
- If outdoors, climb to high ground, stay there and avoid walking through any floodwater, since even water 15 cm deep can sweep you off your feet
- If in a car, turn around and go another way. However, if your car stalls, abandon it immediately and climb to higher ground

4. *What to do after flood*

- Flood dangers do not end when the water begins to recede. Listen to a radio and do not return home until authorities indicate it is safe to do so
- Remember to help your neigbours who may require special assistance such as infants, elderly people, and people with disabilities
- When entering buildings, inspect foundations for cracks or other damage. Examine walls, floors, doors and windows to make sure the building is not in danger of collapsing. Watch for loose plaster and ceilings that could fall. If possible, take pictures of the damage

- Look for fire hazards, such as broken or leaking gas lines, flooded electrical circuits, submerged electrical appliances, flammable and expose materials coming from upstream
- Throw away food including canned goods that has come in contact with flood waters
- Pump out flooded basements gradually (about one-third of the water per day) to avoid structural damage
- Service damaged septic tanks, pits, and leaching systems as soon as possible. Damaged sewage systems are health hazards

Case study:

The 1997-1998 El Niño phenomenon

The 1997-1998 climate phenomenon of "El Niño" severely affected several countries, with considerable impact in Asia, Eastern Africa and Central/South America since April 1997. Floods inflicted 41 countries, while 22 others were hit by drought and two countries by major forest fires. El Niño had far reaching effects on crop production, national food situations, livestock and fish production, and forests and natural vegetation in several parts of the world, according to Mr. Abdur Rashid, Chief of FAO's Global Information and Early Warning System (GIEWS). In addition to livestock losses due to heavy rainfall and floods attributed to El Niño in eastern Africa, ideal conditions developed to create an outbreak of animal and human diseases. For example, Rift Valley Fever (notably in Kenya, Somalia and Ethiopia) resulted in extensive deaths and illness, putting large parts of neighboring countries at serious risk of the epidemic. Regarding its impact on fisheries, El Niño caused severe damage to the area off western South America, which is considered one of the richest fishing regions in the world, producing 12 to 20 percent of the world's total fish landings. One of the greatest El Niño-related threats to forests and natural vegetation was the increased risk of wildfires due to drought conditions.

Source: Food and Agriculture Organization (FAO), 31 Jul 1998

6. Module 5: Earth/Land Movement Hazards (Landslides and Earthquakes)

6.1 Landslides

Module learning objectives

At the end of the training the participants should be able to;

- Define and distinguish different types of earth/land movement hazards
- Identify earth/land movement hazards occurrence in Kenya
- Identify the causes of earth/land movement hazards
- Identify and predict likely impacts of earth/land movement hazards
- Identify and apply earth/land movement hazard mitigation measures.

6.1.1 Understanding landslides

A landslide is the collapse or movement of large amounts of land or rocks. The term 'landslide' includes all varieties of hill slope mass movements and can be defined as the downward and outward movement of slope forming materials including rocks, soils, artificial fills or combination of all these materials along surfaces of separation by falling, sliding and flowing, either slowly or quickly from one place to another. Landslides usually happen on unstable, steep slopes. They can happen suddenly or gradually. Heavy rain falling in areas of unstable land, or on slopes which have been stripped of vegetation, is the most common trigger for landslides. However, earthquakes, volcanic activity and human actions such as inappropriate mining can also cause landslides, especially if these actions occur in areas prone to heavy rainfall. Although landslides are primarily associated with mountainous terrains, they can also occur in areas of surface excavations for highways, buildings and open pit mines. Landslides also occur quite often in conjunction with earthquakes, floods and volcanoes. Landslide prone areas include the following:- (a) Steep deforested slopes, (b) rainwater run-off areas and (c) areas with thick and loamy soil.

6.1.2 Types of landslides

i. **Falls:** Abrupt movements of materials that become detached from steep slopes or cliffs, moving by free-fall, bouncing, and rolling
ii. **Flows:** General term including many types of mass movement, such as debris flow, debris avalanche, lahar, and mudflow
iii. **Creep:** Slow, steady down slope movement of soil or rock, often indicated by curved tree trunks, bent fences or retaining walls, tilted poles or fences
iv. **Debris flow** Rapid mass movement in which loose soils, rocks, and organic matter combine with entrained air and water to form slurry that then flows down slope, usually associated with steep gullies
v. **Debris avalanche** A variety of very rapid to extremely rapid debris flow.
vi. **Mudflow** Rapidly flowing mass of wet material that contains at least 50% sand, silt, and clay-sized particles
vii. **Lateral spreads** Often occur on very gentle slopes and result in nearly horizontal movement of earth materials. Lateral spreads usually are caused by liquefaction, where saturated sediments (usually sands and silts) are transformed from a solid into a liquefied state, usually triggered by an earthquake
viii. **Slides** Many types of mass movement are included in the general term "landslide." The two major types of

landslides are rotational slides and translational landslides

ix. **Topple** A block of rock that tilts or rotates forward and falls, bounces, or rolls down the slope

6.1.3 Parameters of severity of landslides

The following are considered parameters of land slide severity:

- Volume of material dislodged (m^3)
- Area buried or affected (km or Ha)
- Velocity of the slide (cm/day?
- Boulder sizes

6.1.4 Landslide occurrence in Kenya

Landslides are rampant in Kenya during the rain seasons. Many landslides have occurred on the eastern foot slopes of the Aberdare ranges in Central Kenya during the last 50 years. Between 1960 and 1980 about 40 landslides occurred in Murang'a district of Kenya in the eastern foot slopes of the Aberdare ranges. The landslides mobilized an estimated 1 million cubic metres of soil in an area of about 300 km^2. Landslides have also occurred in other areas such as Chebin in Mt. Elgon and Muthambini Division of Meru South District, where over 200 acres of land are affected. It is estimated that property worth millions of Kenya shillings, including coffee and tea plantation and domestic animals have been destroyed by landslides. This was in addition to mobilization of several million cubic meters of agricultural land from the original location to hundreds of meters down slope. The losses caused by landslides have a major negative impact on infrastructure such as power transmission, water supplies and irrigation facilities. The greatest socioeconomic impact of landslides is the loss of life and livelihoods.

6.1.5 What causes landslides?

There are several causes of landslide. Some of the major causes are as follows:

- **Geological causes** - Caused by weakness in the composition and structure of rock or soil
- **Erosion** - Caused by vegetation removal and road construction which can increase the vulnerability of the terrain to slide down
- **Heavy rainfall** - Storms that produce intense rainfall for periods as short as several hours or have a more moderate intensity lasting several days have triggered abundant landslides
- **Human disturbances** - Human excavation of steep slopes through mining, blast vibrations, deforestation, irrigation, and water leakage can trigger landslides
- **Earthquake** - Earthquake shaking has triggered landslides in many different topographic and geologic settings. Rock falls, soil slides and rockslides from steep slopes involving relatively thin or shallow dis-aggregated soils or rock, or both have been the most abundant types of landslides triggered by historical earthquakes
- **Volcanic eruption** - Deposition of loose volcanic ash on hillsides commonly is followed by accelerated erosion and frequent mud or debris flows triggered by intense rainfall

Other causes are:

- Gravitational forces imposed on sloping soils exceed the shear strength of soils that hold them in position
- High water content makes soil heavier, increasing the load, and decreasing shear strength
- Steep cuttings through some types of soils make them unstable
- Triggering of the collapse of unstable soils can be caused by almost any minor event: storms, minor ground tremors or man-made actions
- Liquefaction caused by earthquake vibrations through loose soils, usually with high content

6.1.6 Impact of landslides

Case study: Identify major landslides in Kenya and discuss their social and economic impacts.

Answer: The losses caused by landslides have a major negative impact on infrastructure such as power transmission, water supplies and irrigation facilities. The greatest socioeconomic impact of landslides is the loss of life and livelihoods. For example; it is observed that Gikondi village landslide killed 4 people, Khuvasli landslide killed 9 people, Gacharage slide killed 8 people and Maringa village landslide killed 11 people. In addition to fatalities, several hundreds of people were injured and rendered homeless. Another socio economic impact of landslides is the destruction of property and agricultural land. It is estimated that over 100,000 US dollars worth of property including houses, coffee and tea plantations and domestic animals were destroyed by landslides during the last 10 years in Murang'a District alone. Other socioeconomic impact of landslides also arises from the destruction of roads. The Murang'a-Kiriaini highway is often impassable due to the sliding of deeply weathered volcanic soils which cover sections of the road banks.

It is estimated that property worth millions of Kenya Shillings, including coffee and tea plantation and domestic animals have been destroyed by landslides in the last ten years in some parts of the Central and Rift Valley Provinces. It is further estimated that in the last twenty years landslides in Muranga district alone, caused the loss of over one million cubic meters of soil in an area of 30km^2. The losses caused by landslides also have a major negative impact on infrastructure such as power transmission water supplies and irrigation facilities. To address this problem, appropriate measures such as proper land use are being undertaken by the Government, through proper land use measures to address this problem.

6.1.7 Landslides hazard assessment and mapping

Landslide hazard mapping is the process of locating areas prone to slope failures. This helps to avoid building settlements in such areas. These maps also serve as a tool for mitigation planning. Landslide hazard assessment and mapping techniques should be undertaken to establish previous landslides and ground failures by geotechnical survey. Identification of triggering events should be identified and assessed such as rainfall or earthquake. Other activities considered include:

i. Mapping of soil types
ii. Analysis of slope angles
iii. Mapping of water tables, hydrology and drainage
iv. Identification of man-made features and mounds
v. Investigation into triggering events

6.1.8 Landslide onset and early warning

- Most landslides occur gradually at rates of a few centimeters an hour
- Sudden failures can occur without warning
- Rock falls are sudden but noisy
- Debris flows sudden, but precursory trickles of material may give a few minutes of warning if population is prepared

6.1.9 The following the most at risk elements

- Settlements built on steep slopes and softer soils or along cliff tops
- Settlements built at the base of steep slopes
- Settlements alluvial outwash fans
- Settlements at the mouth of streams emerging from mountain valleys

- Roads and other communication lines through mountains areas
- Masonry buildings
- Buildings with weak foundations
- Large structure without monolithic foundations
- Buried utilities, brittle pipes

6.1.10 Factors contributing to vulnerability to landslides

In many parts of the Mount Kenya region people have expanded their agricultural land to create room for their farm crops. This deforestation means that trees can no longer stop the earth from sliding down hillsides. When this happens many people are buried with the sliding mud. In addition to the influence of topography, landslides are aggravated by human activities, such as deforestation, cultivation and construction, which destabilize the already fragile slopes. Among the factors that increase vulnerability are:

- Population pressure and settlements built on steep slopes of the Aberdares and Mt. Kenya, softer soils and cliff tops which then succumb to gravity when the soil becomes too wet to hold together
- Settlements built at the base of steep slopes, on mouths of streams from mountain valleys
- Construction of roads, communication lines in mountain areas
- Environmental degradation
- Buildings with weak foundations
- Lack of enforcement of the physical planning act allowing people to build in high-risk areas of the province
- Ignorance resulting from lack of understanding of the hazard itself

6.1.11 Landslide mitigation, prevention and risk reduction measures

a. Proper land use practices

Land use planning and regulation is effective and economical way to reduce land slide losses by avoiding and minimizing the risk. This is achieved by discouraging or regulating development in unstable areas.

Areas covered by degraded natural vegetation in upper slopes should be reforested with suitable species. Existing patches of natural vegetation (forest and natural grass land), should be preserved in good condition as landslide buffers. Any developmental activity initiated in a landslide prone area should be taken in accordance with the official land use and land zoning regulations. Total avoidance of settlement in the risk zone should be made mandatory. No construction of buildings in areas beyond a certain degree of slope and any settlements and infrastructure that fall in the possible path of the landslide must be relocated. Road and irrigation canal construction should take proper care to avoid blockage of natural drainage.

b. Rehabilitation of vegetation cover

Increasing vegetation cover is the cheapest and most effective way of arresting landslides. This helps to bind the top layer of the soil with layers below, while preventing excessive run-off and soil erosion.

c. Retaining walls

Retaining walls can be built to stop land from slipping (these walls are commonly seen along roads in hill stations). These are constructed to prevent smaller sized and secondary landslides that often occur along the toe portion of the larger landslides.

d. Surface drainage control structures

The surface drainage control works are implemented to control the movement of landslides accompanied by infiltration of rain water and spring flows.

e. Engineered structures

Structures with strong foundations can withstand or take the ground movement

forces. Underground installations (pipes, cables, etc.) should be made flexible to move in order to withstand forces caused by the landslide

f. Landslide insurance

Insurance will assist individuals whose homes are likely to be damaged by landslides or by any other natural hazards to mitigate the hazard. These can be made a requirement for mortgage loans especially in landslide areas. Landslide insurance is lacking in Kenya. A major obstacle to implementing is lack of technical information, maps and assessment of landslide.

g. Construction codes

Involves enforcing building construction codes in land slide-prone areas to withstand ground failure or soil motion. There is a general standardized building code in Kenya. However, the government has not been effective in using the building codes as a deterrent to the landslide damage in hillside areas.

h. Retrofitting

Involves assessing and where necessary strengthening the structure of existing buildings so as to withstand the impact of landslides or earthquakes particularly in public buildings where people congregate such as hospitals, schools and cinema halls.

i. Landslide monitoring and early warning

Land slide monitoring and early warning are utilized to protect lives and property. These systems provide warning of a slope movement in time to allow the construction of physical means that will reduce the immediate hazard. Specific monitoring techniques include field observation and use of various ground motion instruments such as radar and vibration meters. These instruments can be metered for real time warning.

6.1.12 Community participation

- Recognizing land instability potential and identifying active landslides
- Avoidance of siting houses in hazardous locations
- Construction of strong foundations for structures
- Compaction of ground locally
- Slope stabilization through terracing and forestry
- Rock fall barriers (trees and earth banking)

Assignment:

Discuss measures you can undertake before, during and after a land slide occurrence in your community.

a. What to do in preparation for a landslide

- Know the landslide warning signs especially along roads and highways
- Develop land slide hazard map showing areas susceptible to landslides, probability of occurrence and landslide intensity
- The following are common indicators of an impending landslide
  - The appearance of vertical cracks in the slope, parallel with the slope's direction
  - A sudden appearance of groundwater in new locations
  - Pay attention to the colour of water from wells on and around the slope. If it turns murky then it could be a warning signal of an impending landslide
  - Loose and unstable soil and/or rocks begin to fall
  - Work with your community to undertake the following in your local area
  - Keep an eye the amount of rainfall during rainy seasons
- Work with your community to undertake the following in your local area:
  - Prevent or reduce unsustainable logging to reduce land instability

- Pay special attention to sloped areas by monitoring any signs of crack
- Plant deforested slopes with trees and plants that have strong root systems such as the Neem tree or cedar tree and Cynodon grass
- Construct rainwater channels to drive away excess water
- Retrofitting of existing houses to strengthen them from landslide impact
- Build retaining walls on steep slopes to prevent or control slope movement
- Use perm culture techniques to make swales that keep slopes well formed and channel unwanted water off the slope
- Check land stability and condition

b. What to do during a landslide

- Evacuate immediately to a safe and stable place
- Get away from the area of the landslide and avoid moving materials/rubble
- If evacuating is not possible, roll your body tight like a ball and protect your head. This posture gives you the best physical protection

c. What to do after a landslide

- Avoid the collapsed area, as subsequent landslides may take place
- Check for injured and trapped people, as well as deceased, without directly entering the collapsed area
- Help to guide search and rescue (SAR) personnel to the location
- Help neighbors who need assistance, especially children, the elderly and those with disabilities
- Stay informed about the disaster, by listening to the radio or television for up to date news
- Beware of floods or mudflows following the landslide
- Report damage of public facilities to the relevant authorities
- Check the ground, and house foundations around landslide areas
- Replant the landslide site and surrounding areas to prevent topsoil erosion that can contribute to flooding
- Evaluate the hazards, and work with your community to reduce the risk of future landslides

d. How to reduce landslide impacts

- Build homes and other buildings away from vulnerable areas
- Seek expert advice before building to ensure best results
- Create a hazard map

6.2 Earthquake

6.2.1 Learning objectives

At the end of the training the participants should be able to;

- Earthquake background information
- Identify causes and the occurrence of earthquakes in Kenya
- Identify and predict likely impacts of earthquakes
- Identify and apply earthquakes hazard mitigation measures

6.2.2 Background information

An earthquake is a sudden, rapid shaking of the Earth caused by the breaking and shifting of rock beneath the Earth's surface. Ground shaking from earthquakes can collapse buildings and bridges; disrupt gas, electric, and phone service; and sometimes trigger landslides, avalanches, flash floods, fires, and huge, destructive ocean waves (tsunamis). The African Rift runs through Kenya and it is one of the most earthquake prone areas of the world. The area of the Great Rift Valley within Kenya and parts of Nyanza basin are particularly prone to earthquakes and volcanic activity. Although

earthquake damage and casualties have so far been low, there is need to raise awareness on earthquake hazard preparedness and mitigation strategies.

The Department of Geology, University of Nairobi, Kenya, has been running a seismological station since 1963 as part of the World Wide Standardized Seismic Network (WWSSN). The station was installed for the purpose of monitoring strong earthquakes in East Africa as well as major events World-wide. At present the network consists of five digital and two broadband earthquakes stations which are operating in various parts of the country. Between 1990 and 1995, other stations were installed by the Department at various locations in the country. These locations include Nairobi, Magadi, Meru and Kibwezi. Recently, CTBTO (Comprehensive Nuclear-Test-Ban Treaty Organization) installed a primary seismic station (PS24) at Kilimambogo Hill and the construction of an infrasound station (IS32) is underway at Karura Forest. To improve the efficiency of the network it is planned to install new stations in the following areas: Mombasa (South-eastern Kenya), Maseno (Western Kenya), Garissa (Northern-eastern Kenya), and Turkwel (North-western Kenya).

6.2.3 Mechanism of earthquake destruction

Earthquakes cause destruction through vibration energy transmitted through the earth's surface from depth. Vibration causes damage and collapse of structures, which in turn may kill and injure occupants. Vibration may also cause landslides, liquefaction, rock falls and other ground failures damaging settlements in the vicinity. Vibration may also trigger multiple fires, industrial or transportation accidents and may trigger floods through failure of dams and other flood retaining embankments.

6.2.4 Parameters of severity

The parameters of earthquake severity include:

i. Magnitude scales (Ritcher scale, seismic movement) include the amount of energy release at the epicenter. The size of the area affected by an earthquake is roughly related to the amount of energy released.
ii. Intensity scales (Modified Macalli, MSK) indicate severity of ground shaking at a location. Severity of shaking is also related to the magnitude of energy release, distance away from epicenter of the earthquake and local soil conditions.

6.2.5 Causes of earthquakes

Earthquakes are caused by energy release by geophysical adjustments deep in the earth along faults formed in the earth's crust. Tectonic processes of continental drift. Local geomorphology shifts. Volcanic activity.

6.2.6 Onset and warning of earthquakes

- Sudden onset
- Not currently possible to predict short-term earthquake occurrence with any accuracy

6.2.7 Potential for reducing hazard

There is no potential of reducing this hazard which is inherently geological and within the earth's crust.

6.2.8 Impact of earthquake

The effects of earthquakes include, but are not limited to, the following:

a. Human impacts

Earth quakes usually cause major losses in human life and can result in widespread human injuries and disabilities. Earthquakes

may also lead to disease, lack of basic necessities, loss of life, higher insurance premiums, general property damage, road and bridge damage, and collapse or destabilization (potentially leading to future collapse) of buildings.

b. Shaking and ground rupture

Shaking and ground rupture are the main effects created by earthquakes, principally resulting in more or less severe damage to buildings and other rigid structures.

c. Landslides

Earthquakes, along with severe storms, volcanic activity, and coastal wave attack, and wildfires, can produce slope instability leading to landslides, a major geological hazard. Landslide danger may persist while emergency personnel are attempting rescue.

d. Fires

Earthquakes can cause fires by damaging electrical power lines or gas lines. In the event of water supply lines rupturing and a loss of pressure, it may also become difficult to stop the spread of a fire once it has started.

e. Tsunamis

Tsunamis are long-wavelength, long-period sea waves produced by the sudden or abrupt movement of large volumes of water. Large waves produced by an earthquake or a submarine landslide can overrun nearby coastal areas in a matter of minutes. Tsunamis can also travel thousands of kilometers across the open Ocean and wreak destruction on far shores hours after the earthquake that generated them.

f. Floods

Floods can usually become secondary effects of earthquakes, if dams are damaged. Earthquakes can also cause landslips to Dam Rivers, which then collapse and cause floods

6.2.9 Earthquake hazard assessment and mapping

i. Earthquake hazard assessment is achieved through the following:
ii. Past occurrence of earthquakes and accurate logging of their effects
iii. Identification of seismic faults systems and seismic source regions
iv. Tendency for earthquake to recur in same place over the centuries

6.2.10 Earthquake onset and early warning

On-set is sudden. Currently it is not possible to predict short-term earthquake occurrence with any accuracy.

6.2.11 Elements most at risk

- Dense collections of weak buildings with high occupancy
- Non-engineered buildings constructed by the house-holder: earth, rubble stone and unreinforced masonry buildings.
- Buildings with heavy roofs
- Older structures with little lateral strength, poor quality buildings with construction defects
- Tall buildings from distant earthquakes, and buildings built on loose soils
- Structures sited on weak slopes
- Infrastructure above ground or buried in deformable soils
- Industrial and chemical plants present secondary risks

6.2.12 Mitigation, minimization and risk reduction strategies

Main mitigation strategies include:

- Engineering of structures to withstand vibration forces due to earthquakes
- Seismic building codes
- Enforcement of compliance with building code requirements and encouragement of higher standards of construction quality
- Construction of important public sector buildings to high standards of engineering design

- Strengthening of important existing buildings known to be vulnerable through retrofitting techniques
- Location planning to reduce urban densities on geological areas known to amplify ground vibrations
- Earthquake insurance options
- Seismic zonation and land-use regulations

6.2.13 Community participation

- Construction of earthquake-resistant buildings and desire to live in houses safe from seismic forces
- Awareness of earthquake risk
- Activities and day-to-day arrangements of building contents carried out bearing in mind possibility of ground shaking
- Sources of naked flames, dangerous appliances etc made stable and safe
- Knowledge of what to do in the event of an earthquake occurrence; participation in earthquake drills, practices, public awareness programs
- Community action groups for civil protection: fire-fighting and first aid training. Preparation of fire extinguishers, excavation tools and other civil protection equipment. Contingency plans for training family members at the family level

Assignment:

Discuss measures you could take before, during and after an earthquake.

a. What to do in preparation for an earthquake

- Fasten shelves securely to walls
- Place large or heavy objects on lower shelves
- Store breakable items such as bottled foods and glass in low, closed cabinets with latches
- Hang heavy items such as pictures and mirrors away from beds, couches, and anywhere people sit
- Repair defective electrical wiring and leaky gas connections. These are potential fire risks
- Secure a water heater by strapping it to the wall studs and bolting it to the floor.
- Repair any deep cracks in ceilings or foundations. Get expert advice if there are signs of structural defects
- Contact your local emergency management office for more information on earthquakes
- Teach children how and when to call 9-1-1, police, or fire department and which radio station to tune to for emergency information
- Have Disaster Supplies on hand:
  - Flashlight and extra batteries
  - Portable battery-operated radio and extra batteries
  - First aid kit and manual
  - Emergency food and water
  - Non electric can opener
  - Essential medicines
  - Cash and credit cards
  - Sturdy shoes

b. What to do during an earthquake

If indoors

- DROP to the ground; take COVER by getting under a sturdy table or other piece of furniture; and HOLD ON until the shaking stops. If there isn't a table or desk near you, cover your face and head with your arms and crouch in an inside corner of the building.
- Stay away from glass, windows, outside doors and walls, and anything that could fall, such as lighting fixtures or furniture.
- Stay in bed if you are there when the earthquake strikes. Hold on and protect your head with a pillow, unless you are under a heavy light fixture that could fall. In that case, move to the nearest safe place.
- Use a doorway for shelter only if it is in close proximity to you and if you know

it is a strongly supported, load bearing doorway.
- Stay inside until shaking stops and it is safe to go outside. Research has shown that most injuries occur when people inside buildings attempt to move to a different location inside the building or try to leave.
- Be aware that the electricity may go out or the sprinkler systems or fire alarms may turn on.
- DO NOT use the elevators.

If outdoors
- Stay there.
- Move away from buildings, streetlights, and utility wires.

If in a moving Vehicle
- Stop as quickly as safety permits and stay in the vehicle. Avoid stopping near or under buildings, trees, overpasses, and utility wires.
- Proceed cautiously once the earthquake has stopped. Avoid roads, bridges, or ramps that might have been damaged by the earthquake.

If trapped under debris
- Do not move about or kick up dust.
- Cover your mouth with a handkerchief or clothing.
- Tap on a pipe or wall so rescuers can locate you. Use a whistle if one is available. Shout only as a last resort. Shouting can cause you to inhale dangerous amounts of dust.

c. What to do after an Earthquake
- Expect aftershocks. These secondary shockwaves are usually less violent than the main quake but can be strong enough to do additional damage to weakened structures and can occur in the first hours, days, weeks, or even months after the quake.
- Listen to a battery-operated radio or television. Listen for the latest emergency information.
- Help injured or trapped persons. Remember to help your neighbors who may require special assistance such as infants, the elderly, and people with disabilities. Give first aid where appropriate. Do not move seriously injured persons unless they are in immediate danger of further injury. Call for help.
- Look for electrical system damage. If you have to step in water to get to the fuse box or circuit breaker, call an electrician first for advice.
- Check for sewage and water lines damage.

7. Module 6: Tsunami

7.1 Learning objectives

At the end of the training the participants should be able to;

- Define tsunami
- Identify the causes and occurrence of Tsunami
- Identify and predict likely impacts of tsunamis
- Identify and apply tsunami hazard mitigation measures

Module duration: 45 Minutes

7.1.1 Understanding tsunami

The phenomenon we call "tsunami" is a series of traveling ocean waves of extremely long length generated by disturbances associated primarily with earthquakes occurring below or near the ocean floor. Underwater volcanic eruptions and landslides can also generate tsunamis. In the deep ocean, their length from wave crest to wave crest may be a hundred miles or more but with a wave height of only a few feet or less. They cannot be felt aboard ships nor can they be seen from the air in the open ocean. In deep water, the waves may reach speeds exceeding 500 miles per hour.

7.2 Tsunami occurrence in Kenya

The coastal region is generally low lying and is characterized by an extensive fossil reef which currently lies a few meters above sea level. Kenyan mangrove forests, which serve as a defence against strong waves, have been over-exploited, in some cases completely destroyed and the areas converted to other uses e.g. salt ponds. This has left vast areas bare leading to coastal erosion, reduced fish catches and lack of protection against storm surges and tidal waves. Consequently, Kenya is among the countries in the Western Indian Ocean region that was affected by the December 26, 2004 tsunami. The figure below shows the epicenter of the 2004 tsunami disaster. The impact was, however, much less compared to the devastation in countries closer to the epicenter of the tsunami such as Indonesia, India and Sri Lanka. Malindi Bay and Lamu were most affected because they are wide, shallow and open. Only one life was lost in Kenya. Property destruction of varying magnitudes was experienced along the entire coastline. The fishing industry in Malindi and Lamu was most affected due to destruction of fishing gear, boats and man-hours lost.

7.3 Causes of tsunamis

Tsunamis occur when there is a sudden large displacement of water. There are three main causes of tsunamis: seismic activity, submarine landslides, and cosmic impacts.

7.3.1 Seismic activity

Seismic activity is the most common cause of tsunamis. Both tectonic and subduction earthquakes in and near the ocean may create tsunamis. During a tectonic earthquake, the sea floor becomes deformed, forcing a displacement of water. In a subduction earthquake, tectonic plates slip under each other, creating a massive disturbance, also resulting in a significant displacement of water.

7.3.2 Submarine landslides

Submarine landslides can also cause tsunamis. Submarine landslides occur during earthquakes and the implosion of underwater volcanoes. The falling sediment

and rock in these landslides can also trigger massive water movement, resulting in a tsunami.

7.3.3 Cosmic impacts

Cosmic impacts in the ocean are the least frequent cause of tsunamis. This is similar to throwing a rock into a pond, except on a much larger scale. When the rock hits the water, it creates small ripples of water moving away from the point of impact. In a cosmic impact, these ripples would instead be massive tsunamis, increasing in size as they near the shore.

7.4 Impact and effects of tsunamis

- Human deaths and injuries
- Environmental damage

7.5 Mitigation, minimization and risk reduction strategies

A Post Tsunami Survey of the Kenya coast was carried out in December 2005. The findings showed that Kenya is ill-prepared to deal with Tsunami and other marine hazards. There are no Tsunami Early Warning mechanisms in place. The findings also showed that the impact of the Tsunami as told by the respondents was a clear pointer to more serious impacts should another tsunami of higher magnitude strike the country's coastline.

This calls, therefore, for concerted efforts to put mechanisms in place for purposes of mitigating the negative impacts of such events whenever they occur in future. At the national level, the Government of Kenya designated the Kenya Meteorological Department (KMD) as the National Tsunami Early Warning Centre (NTEWC) with the responsibility of monitoring Tsunami activities in the Indian Ocean. The National (Disaster Operation) Centre (NOC) in the Office of the President, Ministry of State for Special Programmes, was designated as the National Tsunami Information Centre (NTIC) charged with the responsibility of coordinating response, relief and rehabilitation.

The National Tsunami Early Warning Centre (NTEWC) has developed a comprehensive plan to upgrade and strengthen the existing capacity, in a multi-hazard framework as advocated by the international community. 3Real-Time Tidal Gauges with Automatic Weather Stations are being installed at Shimoni in the South Coast and Malindi and Kiunga on the North Coast. 15 drifting buoys have already deployed in Western Indian Ocean and 20 more.

8. Module 7: Lightening and Wild Fires

8.1 Lightening

8.1.1 Module learning objective

At the end of the training the participants should be able to;

- Define lightning
- Identify and predict likely impacts of lightning
- Identify and apply lightning hazard mitigation measures

Duration: 1 hr 30 Minutes

8.1.2 Lightening occurrence in Kenya

A natural hazard resulting from the discharge of static electricity generated in parts of storm clouds. In Kenya, the Western Region has the highest lightening episodes, experiencing about 240 days a year of lightning occurrences.

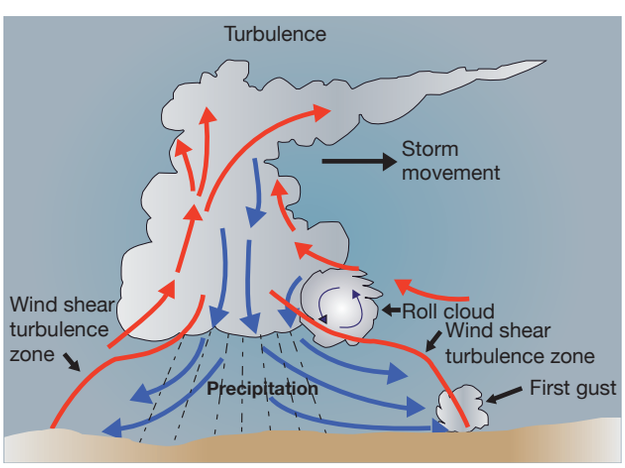
Lightning and thunderstorm

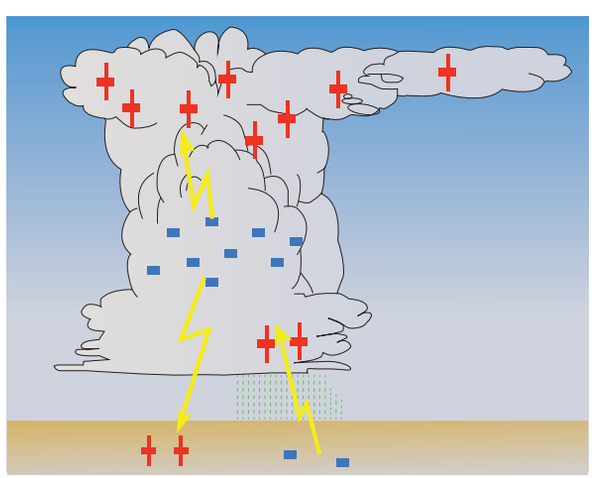
The greatest numbers of aviation weather hazards are bundled up in one single source, the thunderstorm (Fig. 2). A thunderstorm is a violent, short-lived atmospheric disturbance, almost always associated with cumulonimbus clouds (very tall, dense rain clouds) and accompanied by thunder and lightning. Such storms usually generate strong, gusty winds and heavy rain, and occasionally hail or tornadoes. In Kenya strong thunderstorms have been known to occur in areas around Lake Victoria especially Kericho, Kisii, Nandi, Kakamega and the immediate environs. A typical thunderstorm contains strong winds: updrafts and downdrafts. The cold downdraft air of a mature storm flows out like a wedge in a direction that may be completely contrary to the basic wind flow and so producing large shears very close to the ground. The effect on an aircraft which has just lifted off or in the final stage of descent, may be disastrous.

Global distribution of thunderstorm shows that in order to maintain the global fair weather current 1000 to 2000 thunderstorms must be active at any given time. This causes a threat to aviation industry.

Lightening is formed as a result of negatively charged cloud base attracting positively charged ions from the free atmosphere

Figure 8.1: Cross-section of a thunderstorm





thereby creating a positive bubble in the cloud close to its base – tripolar (Fig. 8.2). In fair weather conditions; potential difference between SFC and ionosphere is between 200,000 and 500,000 volt with a fair weather current of about 2x1012 A/m^2. This potential difference is due to worldwide distribution of thunderstorms discussed above. Present measures indicate a loss of 1A to the stratosphere during a typical thunderstorm. Lightning discharge in the atmosphere are detected using the global ATD (Arrival Time Difference) network.

The negatively charged cloud base will attract positively charged ions out of the free atmosphere, thus creating a positive bubble in the cloud close to its base, hence bipolar. There are five kinds of lightning strokes, namely: within cloud, between clouds, cloud base to ground and ground to cloud base.

8.1.3 Parameters of lightening severity

- Number of people or animals killed
- Number of people or animals injured
- Number of property damaged

8.1.4 Causes of lightning

Polarization mechanism in clouds

8.1.5 Impact and effects of lightning

Lightning has disastrous effects

- Death to human beings
- Death of animals
- Destruction to building
- Destruction to telecommunications
- Destruction of power installations
- Destruction of electronics systems

8.1.6 Lightening hazard assessment and mapping

8.1.7 Lightening onset and early warning

- Heavy storm and thunderstorms

8.1.8 Elements most at risk

- Tall buildings with no thunderstorms arresters

8.1.9 Mitigation, minimization and risk reduction strategies

The government should pursue strategies that will promote risk minimizing technologies, particularly formulation of a code of practice for protection of structures from lightning attacks in addition to erecting arrestors in strategic places.

8.1.10 Community participation

- Avoid sheltering under trees when raining
- Put up lightning arrestors on buildings
- Wear rubber soled shoes when raining
- Learn first aid to attend to lightning casualties
- Teaching children not to play out in the rain in lightning prone areas.
- Sitting far from walls when raining
- Switching off electrical appliances when its raining
- Lear fire fighting skills to put out fires in case

8.2 Wild Fires

8.2.1 Learning objectives

At the end of the training the participants should be able to;

1. Define fire
2. Understand the causes and occurrence of fire in Kenya
3. Understand methods of controlling fire
4. Identify and predict likely impacts of fire
5. Identify and apply fire hazard mitigation measures

8.2.2 Definition and background information

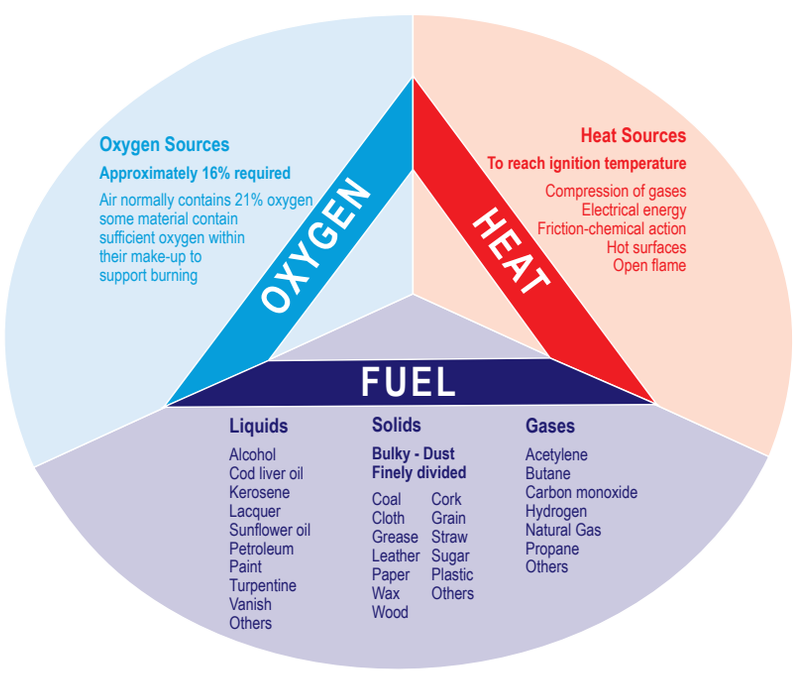
Fire is composed of three elements:

1. Heat- this raises the temperature of a material to its ignition point

2. Fuel- this is the material or substance that burns. It may be solid, liquid or gas
3. Oxygen (O_2) or the air that supports burning. Most fires will burn vigorously in any atmosphere of at least 16% oxygen. Without oxygen, most fuels could be heated yet not burn

The above requirements are presented in a triangle known as the fire triangle as shown in the Figure below. The working together of these three elements forms the fire triangle, which creates a reaction, called fire. If any of these elements is missing or if any is taken away, fire will not occur or will extinguish.

Figure 8 .2: Fire triangle



(Source: Fire Safety Manual, Government of Kenya)

The working together of these three elements forms the fire triangle, which creates reaction, called fire. If any of these elements is missing or if any is taken away, fire will not occur or will extinguish. Fire has been an agent of disturbance for thousands of years. Forest and wildfires have occurred long before the advent of humans, shaping landscape structure, pattern and ultimately the species composition of ecosystems.

Uncontrolled fire has become one of the main environmental issues facing the global community, and in fact, the most important global disturbances, considering the observed effects it has on land area and biodiversity hence the view that "fire is a necessary evil" Natural fires induced by atmospheric lightning were a regular phenomenon even before humans were present. Such naturally-induced fires remain a vital process that initiates natural cycles of vegetation succession and maintains ecosystem viability. In the tropical regions and elsewhere, human-initiated fires have become an important and widespread tool for land clearing and land-use change. Fires initiated by human activities may account for as much as 90% of all fires in the world. Fires caused by human beings are becoming more frequent in Africa.

8.2.3 Wildfires in Kenya

Kenya is highly susceptible to human-induced wildfires because of its location astride the equator. More than 70% of Kenya

is classified as both arid and semi-arid (ASALS) characterized by low biological activity while 30% is classified as high potential. The country's forests are concentrated in the moist central highlands where the human population and agricultural production are also concentrated. In the extensive semi-arid region, forests are mainly found on isolated hills and in discontinuous narrow bands along riverbeds. Kenya gazetted forests comprise some 1.64 million hectares of land (about 3% of the land area). Outside the gazetted forests, there are other large tracks of forests in trustlands i.e. national parks, National reserves and private owned land covering about 0.5 million hectares. This includes:

a. Coastal forest region
b. Dry zone forest region
c. Mountain forest region
d. Western Mau forest region

Table 8.1 shows that the country experienced over 500 fire outbreaks between 1990 and 1999 which gives a rate of 78 fires per year. The leading fire hotspot province in Kenya is Nyanza province followed by Eastern and Rift Valley provinces while the leading districts are Homa Bay, Meru North, Meru South, Nyeri and Machakos. The red flag season for fire outbreaks in Kenya are the dry months of January, March and February (JMF) followed by July, September and August (JSA). The most frequent timings for wildlife outbreaks in Kenya are in the early mornings at 1030hrs and late afternoon at 1600hrs followed by early afternoon at 1500 hrs. This indicates that most of the fires are human-induced. Records show that the causes of most wildfires are undetermined but are mostly attributed to arsonists, followed by poachers and the local people. The figure below shows an example of a wildfire in Kenya.

8.2.4 Methods of extinguishing fire

To extinguish any of the fires, one of the following methods is used;

1. Cooling: This is perhaps the most common method of extinguishing fire. It entails the removal of heat from the fire using water

Table 8.1: Forest fire occurrence in Kenya from 1990 to 2000

Year	Area Burnt			Loss	
	Plantation	Natural Forest	Bush Grass	Suppression Cost	Damage
1990	85	331	12,183	128,600	366,060
1991	1,705	236	6,697	456,420	2,996,340
1992	6,170	5,494	13,301	5,859,300	99,127,400
1993	1,731	515	1,718	500,820	11,901,420
1994	690	69	1,913	3,187,700	37,848,500
1995	-	-	-	-	-
1996	-	-	-	-	-
1997	4,726	2961	7,729	47,729,733	5,979,918
1998	-	-	-	-	-
1999	1,449	317	2,041	25,878,790	28,606,232
2000	861.9	1,229	8,869.75	560.694	38,624,954

Source: UNEP and GoK (December 2000): Devastating drought in Kenya Environmental Impacts and responses

2. Starvation: By starvation, the fire is denied fuel by removing the combustible item
3. Smothering or suffocation: This method employs the Oxygen cut-off system from the fire. Removal of oxygen from fire means that combustion can no longer be supported and so the fire will go off

8.2.5 Causes of fire

Fires can be caused by either man's negligence or forces of nature. Fires can also be caused by erupting volcanoes, drought, or lightning. The four major natural causes of wildfire are lightning, volcanic eruption, sparks from rock falls, and spontaneous combustion. Underground coal fires can also ignite wildfires, and human activity plays a major role. Many are started by arson, and fire is often considered the least expensive way to clear and prepare land for future use. Forested areas cleared by logging encourage the dominance of flammable grasses, and Kenya has had serious outbreaks of environmental fires (bushfires) in forests and grassland areas in the recent past. Most of them caused deliberately or accidentally. Some of these causes include;

- Leaving a fire unattended (at a camp site in national parks, having an open fire on a dry windy day, the glass lens from a bottle or mirror can cause a small flame to become a raging wildfire
- A cigarette or match that has not been put out or accidental or careless act of throwing cigarette but from a moving vehicle which then lands on dry grass and ignites it
- Flammable chemicals that are left in hot areas or in the sun, deliberately by human beings starting fires (arson),
- Clearing of land for farming
- Natural fires may be started by lightning strikes from thunder cloud
- Politics, arson attack and ethnic violence have played a big role to start deliberate environmental fires. Siphoning of petrol or diesel from accident vehicles such as tankers have caused fires which have killed many a people and burnt vegetation next to the main highways, for instance at Sachang'wan-Molo, Kapokyek village near Kericho and many others

Other causes:

a. Negligence e.g. in kitchen fire or when disposing cigarette butts
b. Poor electrification and electrical overload
c. Improper electrical installations
d. Use of sub-standard electrical wiring materials
e. Use of equipments/machine beyond their designed capacities and overloading of electrical systems
f. Lack of knowledge on the nature, characteristic and behavior of fire

There is rampant ignorance on the basic knowledge that for a fire to start three basic elements of fuel, oxygen and minimum heat/source of ignition must be present and come together. This situation is made even worse with the ignorance that once a fire has started it will definitely start spreading to other parts of the building either by conduction, radiation or convection. This lack of knowledge on the nature, characteristic and behavior of fire has led to small fires which could have been effectively managed at the initial stages before developing and growing into big fires that cannot thereafter be effectively be managed. This ultimately results into a disaster.

8.2.6 Classes of fire

Fire is categorized into various classes according to the fuel types as shown in Table 8.2. The class of fire determines the type of fire extinguisher used to put it out.

Table 8.2: Summary of fire categories

Fire Categories	Class Fire Detail	Ideal Extinguisher
A	Ordinary combustibles such as paper, cloth, wood, rubber and many plastics	Water, carbon Dioxide, Dry powder, foam.
B	Flammable liquids	Carbon Dioxide, Dry powder, foam.
C	Flammable gasses	Carbon Dioxide, Dry powder, foam.
D	Combustible metals e.g. magnesium, titanium, potassium and sodium.	Carbon Dioxide, Dry powder.

8.2.7 Fire Institutional arrangements in Kenya

The following institutions are involved in the management of fire disasters in Kenya

1. Ministry of state for Provincial Administration and Internal security
2. National Disaster operations centre (NDOC)
3. Ministry of State for Special Programs (MOSSP)
4. Ministry of State for Defense
5. Ministry of Public works
6. Ministry of Education
7. The City Council of Nairobi
8. The Kenya Red Cross society(KRCS)
9. United Nations Office for the Coordinator of Humanitarian Affairs (UN-OCHA)
10. G4S Fire and Rescue Services (K) ltd
11. Knight support (K) Ltd
12. Kenya National Fire Brigades Association (KENFBA)
13. Securex Fire Service
14. Society for fire and Disaster Emergency Community and Conflict Agency (SOFADECCA)
15. Pascal Systems and Ventures (K) Ltd
16. Upendo Na Utu Society

8.2.8 Fire prevention and mitigation

Forest fires prevention "involves all measures that impede the outbreak of fire or reduce its severity and spread." Effective prevention techniques allow supervising agencies to manage air quality, maintain ecological balances; protect resources, as well as limiting the effects of future uncontrolled fires. Fire prevention and mitigation requires the following: knowledge about the weather, ecology, and terrain of an area; infrastructure for monitoring, such as the availability of satellite images, for example; the ability to mobilize and train human resources; and appropriate communication and road networks, all of which are scarce in sub-Saharan Africa. A few African countries, such as Ethiopia and South Africa, have fire danger warning systems. Kenya is yet to establish an overall fire early warning system.

Wildfire prevention may employ techniques such as:

- Wildfire suppression where a variety of tools and technologies, from throwing sand and beating fires with sticks and palm fronds to full-scale aerial assaults by planes and helicopters using drops of water and fire retardants
- Wildland fire use and prescribed burns where any fire of natural causes is monitored but allowed to burn. Controlled burns are fires ignited by government agencies under less dangerous weather conditions
- Using strategic cuts of trees, fuels may also be removed by hand crews in order to clean and clear the forest, prevent fuel build-up, and create access into forested areas

- Firebreaks and forest boundaries should be established and maintained on regular basis to keep fires from spreading in between plantations and from neighboring settled reserves
- Fire detection should be carried out through ground patrols and fixed stations (fire lookout towers). A few of them have radio system, vehicle, motorcycle and bicycles. When a fire occurs a comprehensive fire report is compiled detailing the location, area burnt suppression cost and the actual damage to the forest
- Early detection efforts focused on early response, accurate day and nighttime use, the ability to prioritize fire danger, and fire size and location in relation to topography
- Satellite and aerial monitoring sensors such as Envisat's AATSR and ERS-2's ATSR can measure infrared radiation emitted by fires, identifying hot spots greater than 39°C (102°F).These more sophisticated systems employ GPS and aircraft-mounted infrared or high-resolution visible cameras to identify and target wildfires

The following strategies can be applied in order to prevent other fire hazards.

a. Electrical hazards

Simple ways that common electrical hazards can be reduced or eliminated include:

- Avoid the "electrical octopus" by eliminating tangles of electrical cords.
- Do not overload electrical outlets.
- Repair or replace malfunctioning appliances

In the event of an electrical fire:

- Know where the switches for electrical appliance are
- Know where the switches for circuit breakers or fuses are and how to shut off the power
- Don't run electrical cords under carpets.
- Replace broken off frayed cords immediately
- Maintain electrical appliances properly.

Note: You should NEVER enter a flooded basement to shut off the electrical supply, because water conducts electricity.

b. Liquefied petroleum gases (LPG)

Liquefied Petroleum Gas (LPG cooking gas) presents two types of hazards as follows:

1. It robs the body of oxygen
2. It is explosive

To reduce LPG (cooking gas) hazards:

- Ensure that the gas is not leaking.
- Turn off the gas when not in using it
- Locate and label the gas switch valves
- During a fire disaster, if you can smell gas, leave the building immediately
- Strike the match stick on before turning on gas and not vice versa
- Ensure there is good circulation of air in the room housing the gas cylinders
- Do not switch on lights or strike a match stick when you detect gas leakage
- Never enter a basement of a structure that is on fire to turn off any utility

c. Flammable liquid hazards

Examples of flammable liquids are petroleum, paraffin and kerosene.

To reduce hazards from flammable liquids:

- Read labels to identify flammable liquids
- Store them properly
- Do not expose them to fires or ignition sources
- Always keep them covered

d. Fire retardant products

Another way of fire prevention is by use of fire retardant products on household furnishes like curtains, carpets and other construction materials which basically prevent flame from spreading by developing a fire extinguishing reaction.

8.2.9 Fire hazard minimization and risk reduction

Fire prevention and mitigation requires the following: knowledge about the weather, ecology, and terrain of an area; infrastructure for monitoring, such as the availability of satellite images, for example; the ability to mobilize and train human resources; and appropriate communication and road networks, all of which are scarce in sub-Saharan Africa. A few African countries, such as Ethiopia and South Africa, have fire danger warning systems. Kenya is yet to establish an overall fire early warning system.

The following strategies can be applied in order to prevent fire hazards:

a. Electrical hazards

Simple ways that common electrical hazards can be reduced or eliminated include:

- Avoid the "electrical octopus" by eliminating tangles of electrical cords
- Do not overload electrical outlets
- Repair or replace malfunctioning appliances

b. Liquefied petroleum gases (LPG)

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Another way of fire prevention is by use of fire retardant products on household furnishes like curtains, carpets and other construction materials which basically prevent flame from spreading by developing a fire extinguishing reaction

a. In the event of fire

- Check for safety (of both self and the victims)
- If safe, have right equipment and training, attack the fire
- If it is not safe, evacuate and call for help

In the event of an electrical fire:

- Know where the switches for electrical appliance are
- Know where the switches for circuit breakers or fuses are and how to shut off the power
- Don't run electrical cords under carpets

- Replace broken off frayed cords immediately
- Maintain electrical appliances properly

Note: You should NEVER enter a flooded basement to shut off the electrical supply, because water conducts electricity.

b. Fire evacuation procedures

- On the sounding of the alarm, people should make their way to the assembly point and gather in an orderly fashion. Do not run
- The fire warden should take the roll call and then report the findings to the coordinator who in turn reports to the fire service on arrival
- Assembly should be quiet and orderly and the fire warden should make sure that the people are not in danger
- At some places, the fire warden should hold a flag/ marker up so that people gather with them
- Use designated fire exits
- Do not use lifts during fires
- Do not go back for your personal belongings
- Have layouts of buildings and all floors marking all exits in the building
- Familiarize yourself with a building layout when in new surroundings. Check for exits and safe passage ways
- Early warning, good fire safety, regular drills and good means of escape are the ingredients for success

c. Fire drill safety checklist

The following are the components of a fire drill that every person must know:

- Know the floor or building layout (plan) - the plan must be displayed in a conspicuous place together with the list of emergency numbers
- Know and differentiate the sound of the alarm from other sounds
- Know all the exits and ensure safety passage ways
- Ensure the building has firefighting equipment in good working order (the equipments must be inspected quarterly)
- Know all the assembly points at your work place, residence or any place you visit

You should conduct fire drills frequently, at least every 6 months.

9 Module 8: Disease Pandemics

9.1 Malaria

9.1.1 Learning objective

At the end of the training the participants should be able to;

- Define malaria
- Identify and predict likely impacts of malaria
- Identify and apply malaria hazard mitigation measures

9.1.2 Malaria

Malaria is a major public health problem in Kenya and a leading killer of children under the age of five years. The Malaria burden varies across the country, from the highly endemic to epidemic prone.

9.1.3 Key facts on malaria in Kenya

i. In Kenya, life expectancy at birth is 58 years (male) and 59 years (female) while the under five mortality rate is 128/1:1,000 or 1 in 8 children die before their 5th birth day
ii. Malaria is a major public health problem in Kenya where population at risk of Malaria being 76% (about 30 million people)
iii. In 2006, Kenya had an estimated 15 million Malaria cases and 40, 000 Malaria deaths majority due to P. faciliparum
iv. 48% of children use ITNs, 39% of children nslept under an ITN the previous night
v. Climate change is expected to lead to increased latitudinal and altitudinal warming which is expected to make the transmission of malaria more intense especially in Sub Saharan Africa

9.1.4 Malaria occurrence in Kenya

Malaria epidemics in Kenya occur in two malaria epidemiological zones – the western highlands and the arid, semi-arid lowlands of northern Kenya. Over 20 million people in Kenya, which is equivalent to 70% live in malaria prone areas and are at risk of infection. Malaria epidemics in Kenya occur in two malaria epidemiological zones – the western highlands and the arid, semi-arid lowlands of northern Kenya (Figure 40). The key malaria provinces in Kenya are as follows (1) Nyanza, (2) Coast, (3) Western and (4) Rift valley. The key red flag districts with regard to malaria epidemics in Kenya are Trans Nzoia, Uasin Gishu, Nandi North, Nandi South, Kericho, Koibatek, Bomet, Narok, Transmara, Buret, West Pokot, Nyamira, Kisii, Gucha and Lugari.

Malaria upsurge in the western highlands of Kenya is an annual event which generally occurs between the months of June-August. In some zones some times, these upsurges break through to above the epidemic threshold. Widespread outbreaks of malaria epidemic involving the western highlands do occur periodically and have been recorded between 1918 and 1950s, when epidemic malaria was a scourge of the economically important Kenyan highlands. Between 1950s and late 1980s the highlands enjoyed a period free of major malaria epidemics. This was as a result of WHO driven eradication programme of the late 1950s which was terminated in the late 1960s (Republic of Kenya, 2001). The most spectacular observed event in many occasions has been a dry spell preceding the outbreaks. The long rain season starts in April/May but the heat wave prevailing during the dry spell persists up to June/

July. This is the most important factor that facilitates massive build up of vector density, thereby increasing the vectorial capacity. The increased transmission level of malaria in an area of susceptible population usually results in malaria epidemics.

9.1.5 Parameters of severity

- Number of cases (patients) seeking treatment in hospitals
- Number deaths

9.1.6 Causes of malaria

The epidemics and pandemics are associated with unusual climatic conditions especially rainfall accompanied by other factors like suitable temperatures that favour breeding and longer survival of the malaria vectors. It is transmitted by a vector, mosquito. Over the past two decades, epidemics of Plasmodium falciparum malaria, often with high case fatality rates, have been common in areas of unstable transmission in Africa.

9.1.7 Impact of malaria

- Loss of lives
- Reduced labour productivity due to increased morbidity
- Mental impairment in case of cerebral malaria
- Miscarriages in pregnant women
- Disruption of academic progress of children
- Diversion of economic resources

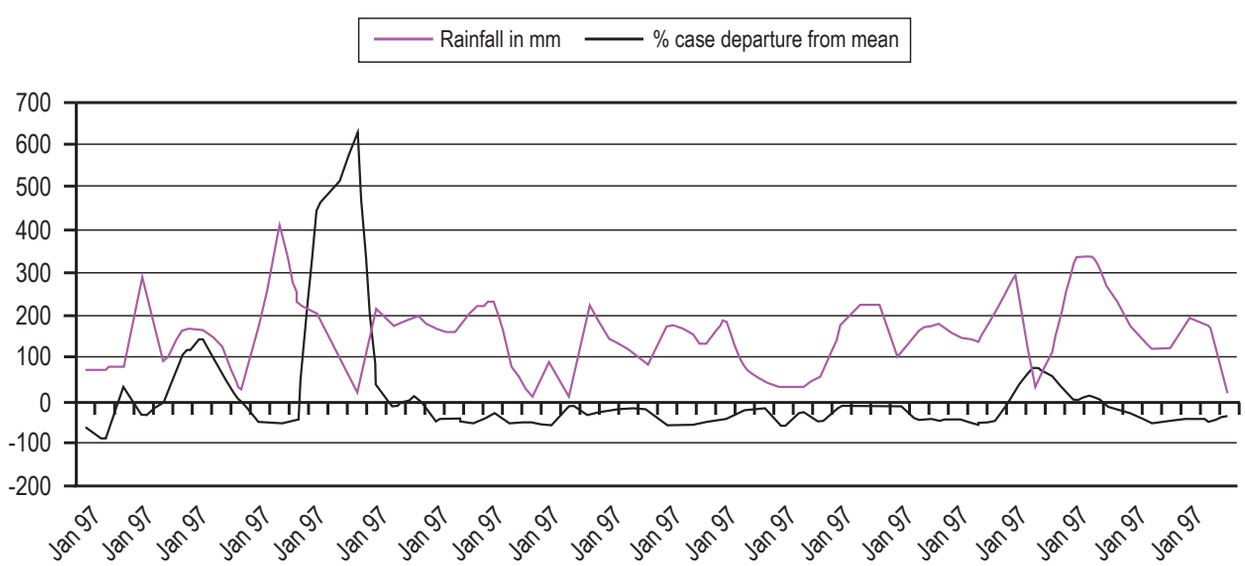
9.1.8 Malaria onset and early warning

Occur with little or no warning. Prediction methods for epidemics to alert implementers to either undertake epidemic prevention measures like indoor residual spraying (IRS) or prepare to control the epidemic are still at developmental stages. Resources are scarce in developing countries and countries find it difficult to keep buffer stocks especially drugs to respond to outbreaks when routine services are without. Once the epidemic has been detected the only cost effective measure is to institute case management activities I health facilities but more than often the resources reach late when the epidemic has burnt itself out. In the highlands, malaria prevalence above the epidemic threshold level last 4-6 weeks.

9.1.9 Elements most at risk

Affect highly vulnerable populations (all age groups) with only limited immunity to

Figure 9.1: Correlation of malaria cases and rainfall in Kericho



(Source, Ministry of Health, 2009)

malaria such as children below five years, the elderly, the poor and People living with HIV/AIDS.

9.1.10 Malaria management institutions

Malaria control in Kenya is undertaken by the Ministry of Health mainly through the National Malaria Strategy (2001-2010) identifies epidemic preparedness and response as a key approach to the containment of malaria epidemics in Kenya. The strategy recommends 80% of detected epidemics to be contained within reasonable time. Due to the current health information systems (HIS) performance, it has been very difficult to detect epidemics as they build up, yet this is the ultimate requirement for effective response so as to significantly affect the magnitude or even avert it. This scenario has made the Ministry of health to modify its approach to malaria epidemic management. Since 2005, there has been a shift from "preparedness and Response" approach to epidemic prevention and control approach.

9.1.11 Mitigation, minimization and risk reduction strategies

Malaria is one of the most serious tropical diseases and can be fatal if not diagnosed and treated at an early stage. The success of malaria epidemic control relies on the choice of intervention to be undertaken at every stage within the epidemic cycle. The following methods can be deployed:

- Preparedness and response strategy requires the retention of buffer stocks of drugs, blood banks and infusion
- Mosquito treated nets (LLITNs/ITNS) can be useful in containing epidemics among the nomadic communities since these are tools that can be carried or used anywhere provided they are used correctly
- Using such methods as environmental management, house screening and biological agents of control are practically difficult in epidemic situations to produce desired rapid effect on transmission
- Vector control options should be implemented on a routine basis as part of community strategy and as control approach of reducing malaria vectors

What to do to avoid infection

- If you are traveling somewhere find out whether there is a risk of getting malaria there. The risk is lower during the cold and dry seasons
- Take precautionary measures to prevent mosquito bites in all risk areas
- If recommended, take appropriate medication as directed
- There is no prophylaxis that is 100% effective, but the correct medicine will reduce your risk of severe illness
- Seek immediate medical attention if you have any "flu-like" symptoms for up to 6 months after leaving a malaria area
- Build houses and villages away from marshy areas and water bodies, which are potential larval breeding sites
- Make provision for optimum drainage of rainwater and household water near houses
- Install gauze screens in front of outside doors and on windows of houses
- Where standing water exists near habitations and cannot be drained, larvicides should be applied to eliminate mosquitoes
- Apply effective non-toxic long-acting insecticides onto the interior walls of houses

Measures to avoid mosquito bites

- Wear long-sleeved clothing, long trousers and socks when going out at night
- Apply an insect repellent to exposed skin at night
- Spray inside with an insecticide spray, after closing windows and doors

- Protect doors and windows with screens, but if not available, windows and doors should be closed at night
- Overhead fans or air conditioners are effective in hindering mosquitoes from landing
- Use a mosquito-proof bed net over the bed (preferably impregnated with an insecticide registered for this purpose, e.g. a pyrethroid), with edges tucked in under the mattress. Ensure that the net is not torn and that there are no mosquitoes inside
- Sleep under a mosquito-proof bed-net, preferably one that has been treated with an approved insecticide (Figure 42) or burn mosquito coils in living and sleeping areas during the night
- Treat clothes with an insecticide registered for this purpose, e.g. a pyrethroid

Early symptoms of malaria

- Fever
- Headache
- Chills
- Muscular pain

If you are diagnosed for Malaria take your medicines correctly

- Take only the medicines recommended by a health professional
- Start before entering the malaria risk area
- Take the medicine at the same time every day (or week, for weekly medication) with plenty of water, after a meal

9.1.12 Community participation

- Use treated mosquito nets
- Drain stagnant water
- Clear bushes around bushes around residential areas
- Go for treatment as soon as symptoms show
- Use insecticides
- Use insect repellants while traveling to unfamiliar places

9.2 Cholera

9.2.1 Learning objective

At the end of the training the participants should be able to;

- Define cholera
- Identify and predict likely impacts of cholera
- Identify and apply cholera hazard mitigation measures

9.2.2 Key facts of cholera in Kenya

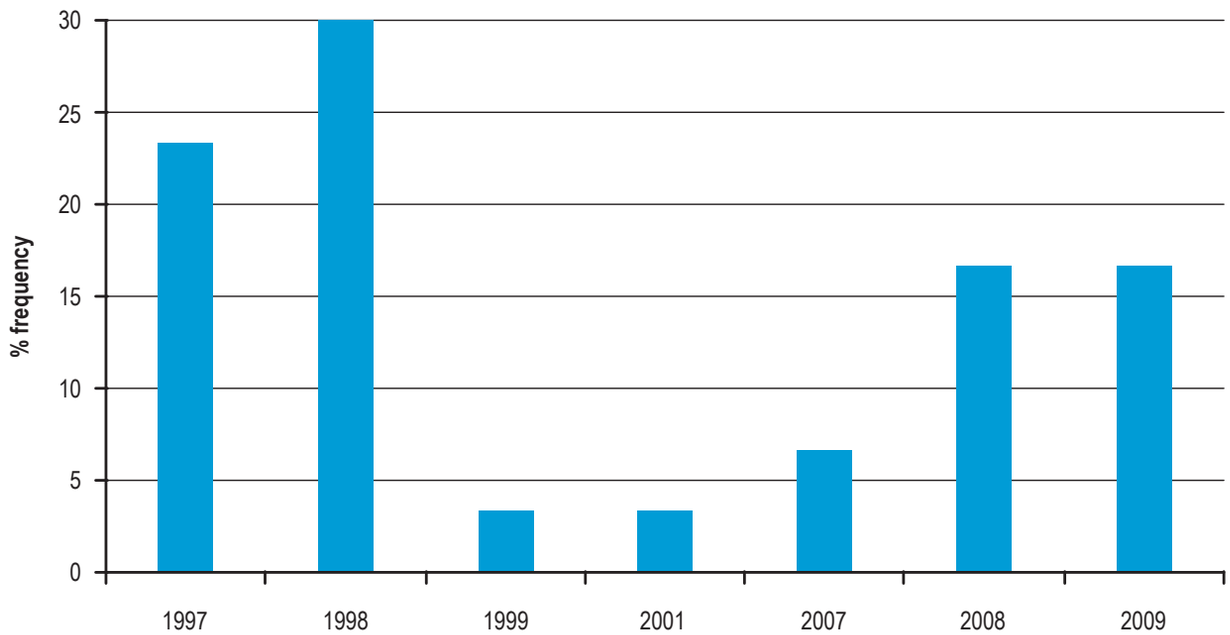
Cholera is an acute enteric infection caused by the ingestion of bacterium Vibrio cholerae present in faecally contaminated water or food.

Kenya Cholera facts:

- 1972 first cholera case reported in Nyanza province
- 1974-1978: Kenya reported cholera cases every year
- 1997-1999: Kenya recorded the largest cholera epidemic with more than 33,400 notified cases
- 2000-2006: Cholera cases were reported each year ranging from 1,157 to 816 except for 2002 with 291 cases
- 2007: Cholera outbreak affected four provinces Rift Valley (West Pokot and Turkana), Coast (Kwale), North Eastern (Garisa, Wajir, Mandela) and Nyanza (Kisumu, Bondo and Siaya)
- 2008: Cholera outbreak was reported in 4 provinces Nyanza (Suba, Migori, Homa Bay, Rongo, Siaya, Kisumu, Bondo, Nyando and South Kisii), Rift Valley (Naivasha and Nakuru)
- 2009: Kenya reported 11,769 cholera cases plus 274 deaths during March-April and October –November

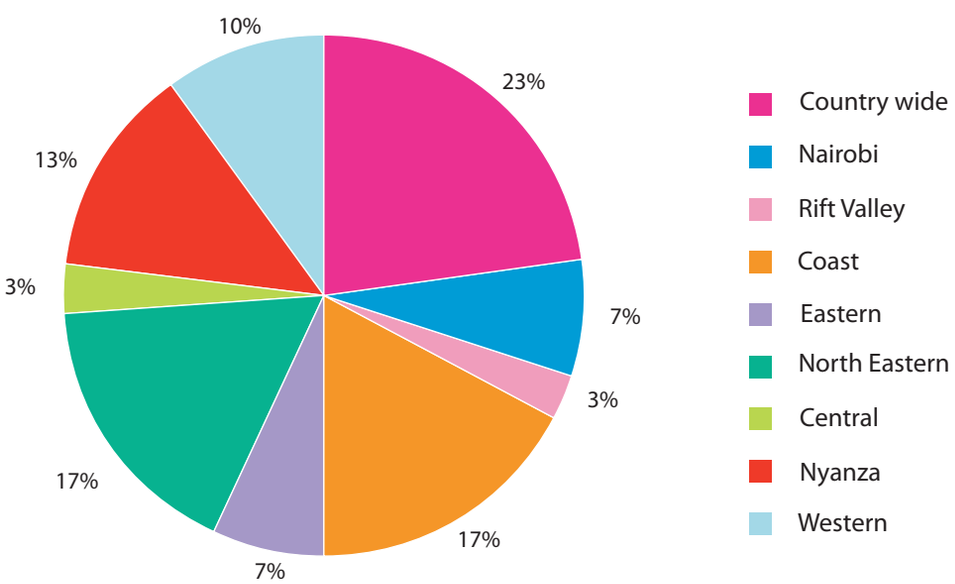
It appears the first cholera case was reported in Nyanza province, followed by Western, Rift Valley, Coast and finally Nairobi.

Figure 9.2: Historical trend of cholera epidemics



(Source: WHO, 2009)

Figure 9.3: Countrywide cholera hotspot provinces



(Source: MSSP)

9.2.3 Parameters of cholera severity

- Number of cholera patients
- Number of cholera deaths

9.2.4 Causes of cholera

- Insufficient access to safe water and
- Lack of proper sanitation
- Areas where basic environmental infrastructures are disrupted or have been destroyed

9.2.5 Impact and effects of cholera

- Loss of lives
- Retarded economic growth
- Increase of orphans

9.2.6 Elements most at risk

- Human population living in water scarcity areas, the elderly and children below the five years
- Population living with no access to improved sanitation facilities
- Population suffering from chronic malnutrition

9.2.7 Mitigation, minimization and risk reduction strategies

Measures for the prevention of cholera mostly consist of providing clean water and proper sanitation and hygiene to populations who do not yet have access to basic services. Health education and good food hygiene are equally important. Communities should be reminded of basic hygienic behaviors, including the necessity of systematic hand-washing with soap after defecation and before handing food or eating, as well as safe preparation and conservation of food. Appropriate media, such as radio, television or newspapers should be involved in disseminating health education messages. Community and religious leaders should also be associated to social mobilization campaigns.

In order to reduce a transmission of Cholera:

i. Safer disposal of faeces, particularly of babies and people with diarrhoea
ii. Hand washing after going to the toilet and handling babies' faeces before feeding, eating and preparing foods
iii. Maintaining drinking water free from faecal contamination in the home and at the source
iv. Provision of safe water, proper sanitation, and food safety are critical for preventing
v. occurrence of cholera
vi. Health education aims at communities adopting preventive behaviour for averting contamination

9.2.8 Potential for reducing hazard

Massive displacement of IDPs or refugees to overcrowded settings, where the provision of potable water and sanitation is challenging, constitutes a risk factor. Therefore, refugee/ IDP camps should be decongested to reduce risk of cholera outbreak.

9.2.9 Community participation

- Enhance sanitation in the house
- Go for treatment as soon as possible and adhere to it to the end
- Use toilets or pit latrines
- Wash hands every time you visit a toilet
- Use treated or boiled water
- Avoid crowded residences
- Ensure clear or proper drainage of the sewer systems
- Avoid eating foods from unfamiliar sources

10. Module 9: Disaster Preparedness and Early Warning

10.1 Module learning objectives

By end of the training participants should be able to;

- Improve efficiency, effectiveness and impact of disaster emergency disaster preparedness and early warning mechanisms at national and community level
- Understand the linkage between disaster preparedness and disaster risk reduction
- Strengthen community Based disaster preparedness and responses through the direct support of community's activities such as education, supporting local community's everyday life reduce disaster risks and strengthen response strategies
- Support activities that are essential in addressing both everyday risks and for responding to disaster situations

Delivery method:

- Power point presentation
- Group discussions
- Role play
- Assignments

Module duration: 30 Minutes

10.2 Understanding "disaster preparedness"

Activities aimed at minimizing the impact of a disaster by strengthening the capacity to provide a timely and appropriate humanitarian response to the needs of affected populations. All pre-disaster activities that are undertaken by society within the context of disaster risk management to reduce disaster risk and vulnerabilities and are based on sound risk analysis are part of disaster preparedness. The activities includes the development and enhancement of overall preparedness strategy, policy, institutional structure, warning and forecasting capabilities and plans that define measures geared to helping at-risk communities safeguard their lives and assets by being alert to hazards and taking appropriate action in the face of an imminent threat or an actual disaster.

Being better prepared to hazards can minimize their adverse effects & is less costly than "waiting" for the response.

10.3 Components of a disaster preparedness mechanism

Traditionally, disaster preparedness has focused on:

i. Contingency planning
ii. Capacity analysis and capacity building
iii. Hazard monitoring, forecasting and warning
iv. Information management and communication
v. Readiness for response/emergency services
vi. Resource allocation/funding

10.4 Disaster preparedness and disaster risk reduction

Disaster preparedness in the context of risk reduction focuses on holistic Hyogo Framework of Action. It encompasses actions to take before, during and after disasters. Pre-disaster preparedness activities are aligned to the HFA as shown in Table 10.1. Disaster preparedness actions during or

immediately after a disaster constitute response strategies, while disaster recovery and rehabilitation activities are undertaken after disaster response.

Adequate disaster preparedness plans can help local and national actors to react swiftly to early warnings of a crisis and mount coordinated responses. The rationale for disaster preparedness is as a result of existence of residual risks that cannot be managed and could cause disasters even in well established societies with better risk reduction measures. Preparedness plans have strong links with education, early warning, risk identification and investments in mitigation. Effective disaster preparedness has to take root at local level.

Priority 5 of the Hyogo Framework for Action (HFA) specifically focuses on the need to strengthen disaster preparedness for effective response at all levels. Implementing Priority 5 requires a common understanding of what constitutes an effective disaster preparedness system - including an understanding of disaster risk factors. The HFA specifically underlines a few key activities that should be undertaken in view of strengthening disaster preparedness at all levels. These are:

- Strengthen policy, technical and institutional capacities in regional, national and local disaster management, including those related to technology, training, and human and material resources
- Promote and support dialogue, exchange of information and coordination among early warning, disaster risk reduction, disaster response, development and other relevant agencies and institutions at all levels, with the aim of fostering a holistic approach towards disaster risk reduction
- Strengthen and when necessary develop coordinated regional approaches, and create or upgrade regional policies, operational mechanisms, plans and communication systems to prepare for and ensure rapid and effective disaster response in situations that exceed national coping capacities
- Prepare or review and periodically update disaster preparedness and contingency plans and policies at all levels, with a particular focus on the most vulnerable areas and groups. Promote regular disaster preparedness exercises, including evacuation drills, with a view to ensuring rapid and effective disaster response and access to essential food and non-food relief supplies, as appropriate, to local needs.
- Promote the establishment of emergency funds, where and as appropriate, to support response, recovery and preparedness measures
- Develop specific mechanisms to engage the active participation and ownership of relevant stakeholders, including communities, in disaster risk reduction, in particular building on the spirit of volunteerism

10.5 Disaster contingency planning

Contingency planning is a management tool used to analyze the impact of potential crises and to ensure adequate requirements are made in advance. This is achieved through the participation of in the contingency planning process as well as through following actions and review of critical planning elements.

Contingency planning is a dynamic process which should be integrated into on-going operational planning activities. It provides useful input to managers. It addresses only scenarios and is field based.

10.6 Early warning systems

Early warning has been defined as the provision of timely and effective

Table 10.1: Holistic disaster preparedness planning indicators with respect to HFA

HFA priority 1 Ensure disaster risk reduction is a national and local priority with strong institutional basis for implementation	**Preparedness indicators** i. National policy and legal framework exist with decentralized responsibilities and capacities ii. Adequate resource available to implement DRR plans and activities at all administrative levels iii. Community participation is existing and with enough resources and authority iv. A multi sectoral platform is existing
HFA priority 2 Identify, assess and monitor disaster risks and enhance early warning	**Preparedness indicators** i. National and local risk assessments based on hazard data and vulnerability is available ii. Mechanisms are available to collect, store and disseminate data on key hazards and vulnerabilities iii. Early warnings are in place for all major hazards with outreach communities iv. National and local risk assessments take account of trans boundary risks
HFA Priority 3 Use knowledge, innovation and education to build a culture of safety and resilience at all levels	**Key milestones and indicators of preparedness** i. Information on disasters is available and accessible at all levels to all stakeholders and networks ii. School curricular, training materials and relevant trainings include disaster risk reduction and recovery concepts and practices iii. Research methods and tools for multi risk assessments are developed and strengthened iv. Country wide public awareness strategy exists to stimulate a culture of disaster resilience and safety
HFA Priority 4 Reduce underlying risk factors	**Key milestones and indicators of preparedness** i. Disaster risk reduction is an integral objective of environmental related policies and plans including land use, planning and adaptation to climate change ii. Social development policies and plans are being implemented to reduce vulnerability of populations most at risk iii. Economic and sectoral policies have been implemented to reduce vulnerability of economic activities iv. Planning and management of human settlements incorporate disaster risk reduction elements including enforcement of building codes v. Disaster risk reduction measures are being integrated into post disaster recovery activities and rehabilitation activities vi. Procedures are in place to assess the disaster risk impacts of major development projects
HFA Priority 5 Strengthen disaster preparedness for effective response at all levels	**Key milestones and preparedness indicators** i. Strong policy, technical and institutional capacities and mechanisms are in place ii. Disaster preparedness plans and contingency plans are available at all administrative levels and regular trainings and drills are held to test and develop response mechanisms iii. Coordination mechanism and information sharing among early warning, disaster risk reduction, disaster response and development in place iv. Emergency funds for disaster response, recovery and preparedness activities established

information through identified institutions that allows individuals exposed to a hazard to take action to avoid or reduce their risk and prepare for effective response. The objective of early warning is to empower individuals and communities threatened by hazards to act in sufficient time and in an appropriate manner so as to reduce the possibility of personal injury, loss of life and damage to property or the environment. Risk assessment provides the starting point for an effective warning system. It identifies potential threats from hazards and establishes the degree of local exposure or vulnerability to hazardous conditions.

Early warning must be complimented by professional services, training and capacity building activities and allocation of resources to enable timely actions are taken to avert loss. The gains in early warning are mainly as a result of growing scientific understanding and the use of modern information and communication technologies. Early warning has always been considered a cornerstone of disaster reduction.

Advances in science and technology during the last decade have improved the potential of early warning to reduce human loss. It has also increased the availability of information and early warning about natural hazards and disasters. Improvement in global observation system has enhanced the early detection of medium term climatic conditions such as El Nino event, and contribution to warnings of long term hazards.

Early warning framework

The objective of early warning is to empower individuals and communities threatened by hazards to act in sufficient time and in an appropriate manner so as to reduce the possibility of personal injury, loss of life and damage to property or the environment. Risk assessment provides the starting point for an effective warning system. It identifies potential threats from hazards and establishes the degree of local exposure or vulnerability to hazardous conditions.

Early warning is a major element of disaster risk reduction. It prevents loss of life and reduces the economic and material impact of disasters. To be effective, early warning systems need to actively involve the communities at risk, facilitate public education and awareness of risks, effective dissemination messages and warnings, and ensure there is constant state of preparedness.

Effective early warning system requires strong technical foundations and good knowledge of the risk, but must be people-centered.

Effective early warning system must be embedded in an understandable manner and relevant to the community which they serve.

The key elements of people-centered early warning systems

A complete and effective early warning system comprises four inter-related elements, spanning knowledge of hazard and vulnerabilities through to preparedness and capacity to respond.

i. Risk knowledge. Risks arise from the combination of hazards and vulnerabilities at a particular location. Assessments of risk require systematic collection and analysis of data and should consider the dynamic nature of hazards and vulnerabilities that arise from processes such as urbanization, rural land-use change, environmental degradation and climate change. Risk assessment and maps help to motivate people, prioritize early warning system needs

and guide preparations for disaster prevention and responses

ii. Monitoring and warning service. Warning services lie at the core of the system. There must be a sound scientific basis for predicting and forecasting hazards and reliable forecasting and warning system that operates 24 hours a day. Continuous monitoring of hazard parameters and precursors is essential to generate accurate warnings in a timely fashion. Warning services for different hazards should be coordinated where possible to gain the benefit of shared institutional, procedural and communication networks

iii. Dissemination and communication. Warnings must reach those at risk. Clear messages containing simple, useful information are critical to enable proper responses that will help safeguard lives and livelihoods. Regional, national, and community level communication systems must be pre-identified and appropriate authoritative voices established. The use of multiple communication channels is necessary to ensure as many people as possible are warned, to avoid failure of any one channel, and to reinforce the warning message

iv. Response capacity. It is essential that communities understand their risks; respect the warning service and know how to react. Education and preparedness programmes play a key role. It is also essential that disaster management plans are in place, well practiced and tested. The community should be well informed on options for safe behavior, available escape routes, and how best to avoid damage and loss of property

Example of early warning and response in Turkana District Kenya

Table 10.1 shows the indicators used in the EWS in Turkana.

Table 10.1: Example of drought EW indicators in Turkana District, Kenya

	Indicators Monitored	Method of Monitoring
Monitoring of endowments	Rainfall Water sources Vegetation cover Crop harvest Crop harvest	Rain gauges/satellite images Aerial surveys/community surveys Community surveys/aerial surveys/satellite imagery Household surveys/community surveys Household surveys/community surveys
Monitoring determinants of entitlements	Livestock sales and prices Livestock pathology and mortality Livestock nutritional condition Livestock production Livestock numbers and distribution	Household surveys/community surveys Household surveys Household surveys/community surveys Household surveys/community surveys Aerial survey
Opportunities to change livelihoods	Income generating activities Number of displaced people Breaking up of households	Household surveys Household surveys Household surveys
Rights	Not monitored	
Monitoring of well-being	Nutritional surveillance of under 5 Diet	Household surveys/community surveys Household surveys/community surveys

Source: Own creation based on data from TDCPU, 1992

Drought EWS stages for Turkana District

Normal: environmental, livestock and pastoralist welfare indicators show no unusual fluctuations but remain within the expected seasonal ranges.

Alert: environmental and livestock stress indicators start to fluctuate outside the expected seasonal ranges with certain localized areas.

Alarm: Environmental and livestock stress indicators start continue to fluctuate outside the expected seasonal ranges. Pastoral welfare indicators begin to fluctuate outside expected ranges. Reports of displaced population groups due to collapse of the pastoral system become more frequent.

Emergency: environment and the pastoral population are in a state of emergency. Displacement of herders and their families continues due to large-scale mortality of livestock and the further collapse of the pastoral system. All indicator values including those of pastoralist welfare fall to minimum levels.

Source: ALRMP, 2009

10.7 Code of conduct in disaster response

The Government of Kenya has recommended a Code of Conduct that shall guard our standards of behaviour in disaster response (RoK 2009). It seeks to maintain the high standard of efficiency, effectiveness and impact to which disaster relief agencies aspire. It shall be a voluntary code enforced by the will of organizations accepting to maintain standards laid down in the code. The 10 point codes of conduct are as follows:

1. Humanitarian imperative comes first in order to alleviate human suffering
2. Aid is given regardless of race, creed or nationality of the recipients and without adverse distinction of any kind. Aid priorities are calculated on the basis of needs alone
3. Aid will not be used to further a particular political or religious standpoint
4. We shall respect culture and customs.
5. We shall endeavour not to act as instruments of Government foreign policy
6. We shall attempt to build disaster response on local capacity
7. We shall be found to involve programme beneficiaries in the management of relief aid
8. Relief aid must strive to reduce future vulnerability to disaster as well as meeting the basic needs
9. We hold ourselves accountable to both those we seek to assist and those from whom we accept resources
10. In our information, publicity and advertising activities, we shall recognize disaster victims as dignified human beings and not objects of pit

11. Recommendations on Awareness Raising Strategies

Public awareness can be raised in a number of ways, from short-term, high-profile campaigns using broadcasts, literature and posters, to more long-term, low-profile campaigns that are carried out through general education. Education should attempt to familiarize and de-sensationalize. The awareness should target both high level policy makers and the community to enhance synergy and have common understanding on DRR.

11.1 Increasing awareness to district and sub national level personnel

This will be achieved through seminars and workshops. At least one workshop for district level personnel should be held to raise their awareness should be conducted. No meaningful DRR strategy can be achieved without sensitizing local community based and sub-national actors on the hazards and their effect on people and property. District level and sub national personnel when sensitized on DRR can help accelerate awareness raising for disaster reduction activities.

11.2 Increasing community awareness

Community hazard/disaster awareness are initiatives which inform and train local populations about how to prepare for natural disasters and emergencies can reduce a population's vulnerability to specific hazards. These initiatives need not require large financial outlays nor do they require the work of a great number of people. What is required for planning purposes is a awareness strategy that is opportunistic in its timing and which is integrated with other local and community development strategies. Risk awareness approach entails planning a series of coordinated activities—for example, a comprehensive awareness campaign may be implemented during a disaster awareness week, when the media publicizes disaster messages on the radio, T.V. and in newspapers; schools conduct poster contests and perform disaster drills; and community centers display disaster posters.

Community disaster risk awareness activities generally relate to one or more of the following themes:

- The potential disasters, emergencies and hazards specific to a region, and their effects
- Low-cost measures local populations can take to prevent and prepare for disasters and emergencies
- Measures the government and official emergency and disaster managers are taking to prevent prepare for and respond to disasters
- Official disaster public warning and information systems, evacuation routes, temporary shelters and how and when this information will be communicated

11.3 Communication tips on public awareness

DA messages vary based on the audience and the specific medium to be used (i.e. brochure, poster, and newspaper advertisement). DA planners must understand their primary audience— i.e. those who will receive and act on the DA information. In addition, planners should follow some basic disaster communication guidelines, which include:

- The nature and potential of the risk
- The human and physical elements that are most vulnerable or most-at-risk

- Safety actions to prevent and prepare for a potential disaster
- Safety and survival actions to take when the disaster is occurring
- Safety, survival and recovery actions to take after the disaster has occurred
- Official sources to contact for additional information

11.4 Planning public education initiatives

This section covers the following steps for planning a disaster risk awareness effort.

i. Define the purpose and objectives of the awareness initiative
ii. Select and analyze primary audience(s)
iii. Form a disaster awareness planning team
iv. Form collaborative community partnerships
v. Schedule the time and location of disaster awareness events for maximum impact
vi. Brainstorm potential activities and resources
vii. Determine the proper medium or format
viii. Develop, implement and monitor the action plan

11.5 The seven DRR potential partners

All organizations have a vested interest in protecting their employees and facilities in case of a disaster. Potential partners are:

i. Schools, colleges and universities
ii. Religious organizations
iii. Youth clubs, students' (hostels) dormitories
iv. Village elders
v. Women's clubs, organizations
vi. Trade enterprises, associations
vii. Television stations

Activities and events for raising hazard/ disaster awareness

The following lists can be used to stimulate creative thinking among the planning team about how they might deliver DA messages and information.

- Create displays in public buildings or gathering places to portray hazards and past disasters
- At times of seasonal risk, ask utility companies to include "stuffers" with their bills, identifying hazards and instructing citizens what to do when disasters strike
- Ask employers to distribute risk information brochures to their employees
- Post seasonal information in a variety of places—on milk cartons, bread wrappers and shopping bags

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