Conceptual Understanding of Disaster Risk Management

Module prepared by: Tesfahun Asmamaw

Editor: Markos Budussa

Layout and Graphics Designer: Jemal Simeneh

Language Editor: Tesfaye Dagnew (Ph.D)

Disaster Risk Management and Sustainable Development Department,
Bahir Dar University

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Foreword

Ethiopia is exposed to a wide range of hazards associated with the country’s diverse geo-climatic and socio-economic conditions. The reduction of disaster risk and its impacts is urgent priorities which contribute to the path of economic and social development set forth for Ethiopia by the Growth and Transformation Plan (GTP). Based on the country’s deep-rooted history of disasters and the past disaster management experience, the government of Ethiopia has been taking remarkable policy and institutional measures over the last two decades to transform the DRM system from relief oriented approach to primary focus on reducing disaster risk developmentally.

One of the major bottlenecks to combat disaster in Ethiopia has been lack of trained human power. Thus in response to the ongoing need to build disaster resilient communities through strengthening human and institutional capacity, Bahir Dar University established the Department of Disaster Risk Management and Sustainable Development (DDRMSD) in 2005, which has since then been running both a graduate and an undergraduate program in Disaster Risk Management and Sustainable Development.

In addition to these programs, BDU, in collaboration with DRMFSS and UNDP, has developed these short term training modules to respond to the need for developing capacities of the DRM workers who are already in the service as DRM practitioners and experts as well as decision makers, working for GOs, UN agencies and NGOs. These short-term training modules will be a major step in the standardization of concepts, approaches and methodologies within the Disaster Risk Management sector.

I hope that those who use these training modules and apply the concepts and principles will be inspired and better equipped to alleviate the negative impact that disasters have on the lives and livelihoods of our citizens.

Frew Tegegn (PhD)
BDU Academic Vice President
03 July 2014
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This work was supported by UNDP as part of the agreement between BDU-DRMFSS/UNDP. In pursuit of our aim to professionalize and standardize concepts of disaster risk reduction, food security and climate change. Bahir Dar University, Department of disaster risk management & Sustainable Development would like to offer our sincere thanks to DRMFSS-UNDP for their generous financial support to prepare this module.
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INTRODUCTION: WHY DISASTER RISK CONCERNS ARE IMPORTANT

The current state of disasters and the prevalence of disaster risks in the world present a challenge to all to address the problem of disaster risks as they impact on humanity, the environment and the future. Based on the recent trends of increased toll on human lives, properties, economy and the environment due to disasters and the inadequacy of response and coping systems, the disaster potential of natural hazards and the vulnerability of social systems have worsened.

The disaster potential of natural hazards is likely to intensify because of (1) increase in population and population density; (2) increase in population exposed to natural hazards; (3) increased use of hazard-prone land for productive purposes; and (4) expected increase in hazard intensity and/or frequency due to climate change and other human interventions into geo-chemical cycles.

As disaster potential increases, the coping mechanisms of many societies tend to become less effective. Moreover, vulnerability tends to increase due to the (1) speed of urbanization; (2) insufficient speed in building infrastructures to cope with urbanization; coupling of independent risk sources (interaction of natural hazards with chemical, technological, lifestyle, and social risks); (3) increase of mobility and cultural de-rooting (loss of traditional management capabilities); (4) increase of social pressure and conflicts; (5) insufficient management capacity; (6) lack of capacity for mitigation and contingency management.

Furthermore, although risk assessment has played an important part in disaster management, the many uncertainties brought about by recent global developments have limited the reliability of recent risk assessments in view of the following: (1) unpredictable global climate changes have a definitive but not fully understood impact on the occurrence and magnitude of disasters precipitated by natural hazards; (2) the combined effects of several natural phenomena aggravate the potential damage; (3) the estimation of probabilities and damage
potential depend largely on social and political context; (4) because of population density and increased use of technologies, natural events trigger secondary impacts released from technologies and other human-made facilities; and (5) natural catastrophes interact with technological, social, and lifestyle risks.

Therefore, understanding the context of the current state of disasters and prevalence of disaster risks through dynamic and holistic conceptual/theoretical frameworks enhances efforts to develop an effective and holistic risk management approach to disaster management. Hence, this module provides a basic understanding of the nature of disaster risk and its management. It introduces terms, concepts, frameworks and approaches related to disaster risk management. Making a clear understanding of the theoretical and applied disciplines that define disaster, vulnerability and risk is the main objective of this training module.

**MODULE CONTENT:**

This training module is divided into two broad sections and six chapters.

**SECTION A: THEORETICAL AND CONCEPTUAL BACKGROUND**

This section introduces theoretical and conceptual understanding of disaster risk and creates an awareness of its key-issues that should be considered in the process of disaster risk management. It includes four chapters:

- Chapter 1 - understanding disasters
- Chapter 2 - understanding hazards
- Chapter 3 – understanding vulnerability
- Chapter 4 – understanding risk

**SECTION B: DISASTER MANAGEMENT APPROACHES AND PROCESSES**

This section introduces the conceptual and practical paradigm shift in disaster management approaches and raises awareness about the nature of different disaster management
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approaches. Such awareness is useful in appreciating the role of a holistic and proactive approach to disaster reduction. It also introduces the process of disaster risk management and raises awareness about the basic interrelationship between components of the process of disaster risk management. It includes two chapters:

- Chapter 5 – disaster risk management approaches
- Chapter 6 – process of disaster risk management

TRAINING OUTPUTS:
- To become familiar with concepts related to disaster risk management
- To become aware of the different approaches to disaster risk management
- To become aware of the comprehensive process of disaster risk management

TRAINING METHODS:
This module is intended for two audiences, the self-study learner and the participant in a training workshop. The following training methods are planned for use in workshops. The text in the module is also prepared taking the context of self-study learners into consideration. Workshop training methods includes:

- group discussions
- supplementary handouts
- videos
- review sessions
- critical reflections
CHAPTER 1: UNDERSTANDING DISASTERS

General description:
This chapter introduces the context and key terms related to disasters and raises awareness about what constitutes disasters. Such awareness is useful in understanding the nature of disaster risk management.

Learning Objectives:
At the end of this chapter, the participants will be able to:

- Understand what constitutes disasters
- Describe the changing nature of disasters
- Explain the relationship between disasters and development processes
- Define and understand disaster related terms and concepts

Key concepts:
- There is nothing ‘natural’ about disasters. There are only natural hazards and only the interaction between these natural events/processes and human elements would result in ‘unnatural’ disasters.
- Disasters triggered by natural hazards are a major threat to life and sustainable development, especially in developing countries.
- The human and economic cost of disasters is rising, mainly because societies are becoming more vulnerable to hazards.
- The number of disasters is increasing, mainly because of climate change, urbanization and associated land degradation.
- Socio-economic vulnerability is complex and often deep-rooted.
- The poor and weaker groups in society suffer the most from disasters.
- Many persistent myths about disasters should be discarded.
1.1 WHAT ARE DISASTERS?

The term disaster is derived from the Latin roots *dis*- and *astro*, meaning ‘away from the stars’ or, in other words, an event to be blamed on an unfortunate astrological configuration. Disasters occur when a hazard risk is realized. However, to be considered disastrous, the realized hazard risk must overwhelm the response capability of a community. Internationally, disaster, as defined by the UN, is ‘a serious disruption of the functioning of society, causing widespread human, material or environmental losses which exceed the ability of the affected society to cope using only its own resources’. Given this definition, the following issues need to be considered in understanding what constitutes ‘disasters’.

1. **There is an important distinction between an event and a disaster.** Not all adverse events trigger disasters; only those that overwhelm response capacity can be called disasters. For instance, simple house fires that are routine occurrences and can be easily managed by communities are not considered as disaster. However, the same ‘fire’ event in large scale affecting a very large portion of population, causing significant property damage and ecosystem disruption can be called a disaster. Hence, the scale of damages and losses associated to the occurrence of adverse events in relation to the capacity of affected communities in managing the consequences of adverse events determine whether a realized hazard risk can be called a disaster or not.

2. **Disasters can be categorized as international, national and local based on the scale of response required to manage its adverse consequences.** Disasters grow in intensity as they overwhelm progressively larger response units. A local disaster is not a national disaster if a local response body can manage the consequences. However, if the local response body could not manage the consequences of an adverse event, the disaster becomes national, thereby requiring the intervention of the national government. Similarly, in situations in which a national government or several national governments are unable to manage the consequences of an adverse event, the event becomes an
international disaster, requiring intervention by a range of international response and relief agencies.

3. **Measuring disasters requires understanding of socio-economic and environmental consequences of adverse events.** They can be measured in terms of the lives lost, injuries sustained, property damaged and environmental degradation. These consequences manifest themselves through both direct and indirect means, and can be tangible or intangible. Understanding each of these measures is of great importance in analyzing the risk associated to the disaster event.

4. **Disasters may be sudden onset or ‘creeping’ in nature.** Sudden-onset disasters often happen with little or no warning, and most of their damaging effects are sustained hours or days. For example, some of these disasters are, triggered by earthquakes, tsunamis, volcanoes, landslides, tornadoes, and floods. Creeping disasters occur when the ability of response agencies to support people’s needs degrades over weeks or months, and they can persist for months or years once discovered. Some of these creeping disasters are triggered by drought, famine, soil salination, the AIDS epidemic, and land degradation.

5. **Disasters are not always limited to a single hazard.** Sometimes, two or more completely independent disasters occur at the same time. For instance, an earthquake might strike during a flood and could trigger a compound disaster. More commonly, one disaster associated to the occurrence of a primary hazard triggers a secondary hazard to occur. Some secondary hazards only occur as a result of a primary hazard, such as a tsunami (from earthquakes, volcanoes, or landslides), while others can occur either because of or independent of other disasters (such as landslides, which can be triggered by heavy rains, earthquakes, volcanoes, or other reasons, or occur purely on their own). Compound disasters, which can occur either sequentially or simultaneously with one or more disasters, have a tendency to exacerbate consequences and increase victim’s
issues and continually undermine the capacity of responsible bodies to manage escalating consequences of compound disasters. Hence, understanding the nature of disasters requires the consideration of multiple effects of compound hazards that can trigger compound disasters.

6. **There is no such thing as ‘natural disaster’ but there are natural hazards.** Several notable disaster experts such as Wisner argued that there is nothing ‘natural’ about disasters. A disaster should be defined on the basis of its human consequences, not on the phenomenon that caused it. An earthquake, for example, is simply an event in nature. Even a very strong one is not a disaster unless it causes injury or destroys property. Thus, an earthquake occurring in an uninhabited area (as do scores of major tremors each month) is only of scientific interest and is not considered a disaster; rather it is just a natural event. Therefore, it can be said that nature causes extreme events (called “hazards” when they threaten people), but people create disasters by: making faulty assessments of natural hazard risks; undermining the resilience of impacted natural and social systems; and failing to practice appropriate protective measures.

### 1.2 GLOBAL DISASTER TRENDS

Although several factors considerably reduce the meaningfulness of disaster statistics, increased accuracy in the reporting of disaster statistics over the last few decades has helped to understand that the nature of disasters is rapidly changing. Different definitions and classifications of disasters as well as the difficulty to consider indirect and long term effects of disasters can lead to varying interpretations of disaster trends in their frequency and associated consequences. However it is now unequivocal that the nature of disasters is rapidly changing, and that these changes generally result from human actions and changing development patterns. Recent trends indicate that: the overall number of people affected by disasters is rising; overall disasters are becoming less deadly; overall disasters are becoming more costly;
the number of disasters is increasing each year; and poor countries are disproportionately affected by disasters.

**Trend 1: The Overall Number of People Affected by Disasters Is Rising:**

The world population is not only increasing; its distribution around the globe is also changing dramatically. Large proportion of the world’s population growth in the coming decades will take place in the cities of the less developed countries. In 2015 the world will have 58 cities with more than five million inhabitants. Only ten of these will be in the industrialized countries, with the vast majority in developing countries. Around half of the world’s population already lives in urban centers; by 2030 the proportion will have risen to almost two-thirds. Higher rates of population growth and urbanization assume high concentration of risk of adverse events.

Given that population growth and urbanization are particularly the characteristics of developing countries, there are several explanations for the rising number of people affected by disasters:

1. Higher population density means that potential victim numbers are much higher in cities than in rural areas. Because of the concentration of goods and services in cities the potential economic damage is also enormous.

2. Building methods that are not adapted to existing risks and the absence or inadequate implementation of disaster-preventive building codes result in rising number of people affected by disasters.

3. Cities in developing countries often face rapid and uncontrolled urban growth and slum building. The capacity for risk reduction through urban planning is often limited. As a result, many settlements are located in hazard zones. Hence, since these high risk areas periodically experience major disasters, the number of people affected by disasters tends to increase.
4. Illegal settlements are often established in high-risk locations such as river flats or slopes where there is risk of landslides. In the event of a disaster, effective cooperation between illegal settlers and civil protection authorities is unlikely. In post-disaster reconstruction, illegal slum-dwellers are also disadvantaged because they have no legal basis for their claims. Therefore, increasing number of settlers in high-risk areas of cities with little or no preparedness and contingency planning would assume rising number of people affected by disasters.

**Trend 2: Overall Disasters Are Becoming Less Deadly:**

Although the number of disasters has more than tripled since the 1970s, the number of people affected by disasters has fallen by 50%. The efforts of the UN, the many nongovernmental agencies involved in disasters preparedness and response, as well as the efforts of individual governments have considerably contributed to the reduction in the number of deaths associated with disasters. The following are some of the explanations for the falling fatality rates of disasters:

1. More organized and comprehensive preparedness campaigns are helping individuals and communities to decrease their vulnerability and to react more appropriately in the face of disaster.

2. Early warning systems are giving potential victims more time to remove themselves from the dangerous situations associated with impending disasters.

3. Special disaster-specific protection structures, such as tornado safe rooms, are mitigating the impact that disasters have on human life.

4. Building code creation and enforcement are helping to increase the resilience of the various structures and systems upon which humans depend.
5. Secondary, post disaster consequences, such as famine and disease, are being more effectively managed by modern-public health response mechanisms.

6. Proper zoning procedures and enforcement are helping to prevent people from moving into the path of disasters and helping to remove those who already are there.

7. Sustainable development processes are helping to reduce population movement into areas of highest risk.

**Trend 3: Overall disasters are becoming more costly:**

The cost of disasters worldwide is increasing at an alarming rate. In the 1990s, the total global economic costs of disasters with a natural trigger exceeded $US 608 billion. This figure is three times the total economic loss of 1980s and 9 times to that of 1960s. By 2050, economic costs of disasters associated with natural adverse events are expected to reach $US300 billion, annually. The fact that people continue to move toward urban centers and build expensive structures and infrastructure in the path of hazards explains that disasters are getting more expensive with enormous potential economic damage.

The following are some of the explanations for the rising financial cost of disasters:

1. Increasing urbanization in high-risk zones is occurring throughout the world. Concentrating wealth, physical structures, and infrastructure together in high-risk zones increase the financial risk.

2. Economies are much more dependent upon technologies that tend to fail in times of disaster and assume greater financial risk.

3. Due to the nature of globalization, areas not directly affected are experiencing secondary economic consequences of disaster, as with many world economies following the September 11, 2001, terrorist attacks in the United States.
4. A greater number of less deadly but financially destructive disasters are occurring throughout the world as a result of climate change and ‘everyday hazards’.

Trend 4: Poor countries are disproportionately affected by disasters.

Poverty is one of the major causes of deaths associated with natural disasters. More than half of all deaths from natural disasters occur in underdeveloped countries. Between 1991 and 2000, half of the disasters took place in countries with a medium HDI (Human Development Index), while two-thirds of the deaths occurred in countries with a low HDI. Only two percent of the deaths occurred in countries with a high HDI. Hence, there is a strong correlation between development and vulnerability to the impacts of hazards. Given that around one billion people live in absolute poverty and more than two billion suffer from malnutrition, according to the World Bank, poor sections of the population would incur the greatest impact of disasters.

Box 1.1: The magnitude of a hazard ≠ the disaster impact

One person died in an earthquake of strength 8 in Hokkaido, Japan, in 2003, while in the same year an earthquake of 6.5 in magnitude killed 22,000 people in the Iranian city of Bam. These figures show that a society’s vulnerability has a major influence on the impact of an extreme event. And the poor sections of the population in a given society are the most vulnerable to the impacts of disasters triggered by natural and human-induced hazards.

The following are the most common reasons that explain why the poor in general are often the most at risk:

1. Poor sections of the population have only limited access to resources such as water and secure accommodation, education, work, land and health; they are unable to create financial or material reserves, necessary to use as a buffer against the impacts of hazards.
2. Poor people have less access to knowledge and information about steps they could take to reduce their risk.

3. Poor people often migrate to the slums of the big cities, which are frequently located in areas where natural hazards pose an increased risk.

4. The vulnerability of the poor to natural hazards is also affected by their income, ethnic origin, gender and age, and by whether they live in an urban or rural location. Women and children are particularly hard hit by disasters – partly because of their high rates of illiteracy, their limited mobility and their widespread social dependence on male relatives.

**Trend 5: The number of disasters is increasing each year:**

Global disaster statistics indicated that, over time, due to significant interaction between man and nature, the number of disasters resulting in significant loss of life and property damage is increasing. There are two primary explanations for the increasing number of annual disasters. The first is climate change which increases both the frequency and intensity of annual disasters. Particularly, the number of occurrences of hydro-meteorological hazards has increased over the last few years and over 70% of disaster losses worldwide are associated with weather related disasters. The second factor which explains the increasing trend of disaster occurrences is rapid urbanization. Increased human settlement in more vulnerable areas where poor people often migrate to the slums of the big cities, which are frequently located in areas where natural hazards pose an increased risk. Hence, with higher population density in these vulnerable areas, simple hazard occurrences with low magnitude might have a greater likelihood of becoming devastating events.
The traditional view of disasters held that they were temporary interruptions of a linear development process that was leading to ever-improving standards of living. Emergencies are seen as momentary setbacks to the development process, requiring relief and/or rehabilitation assistance to restore the pre-emergency condition, after which the development process continues from where it left off. Emergency relief would be followed by rehabilitation, leading in turn to renewed development work. The underlying causes of vulnerability/poverty and their effect on the process were not taken into consideration. The causal analysis was simple and uni-linear, as indicated in the diagram below.

Vulnerability studies in the 1980s and 1990s showed that development has its own failures, as well as successes. A closer look at natural disasters has undermined the belief that victims’ lives can soon return to normal. Moreover, the development process itself can make people vulnerable to natural hazards. Human vulnerability is becoming increasingly prominent in aid and development thinking. The phrase ‘natural disaster’, which is widely used by specialists and generalists alike, often causes confusion and has been the subject of debate. Strictly speaking, in his paper entitled ‘Disaster Vulnerability: Power, Scale, and Daily Life’, Ben Wisner argued that there is nothing ‘natural’ about ‘natural disasters’.
Critical reflection:

Dear participants, what do you think about phrases such as ‘Natural hazards-Unnatural disasters’? Can you explain why disasters are unnatural?

A disaster takes place when a society or community is affected by a hazard (it is usually defined as an event that overwhelms a society’s capacity to cope). In other words, the impact of the disaster is heavily influenced by the degree of the community’s vulnerability to the hazard. This vulnerability is not natural. It is the human dimension of disasters, the result of the whole range of economic, social, cultural, institutional, political and even psychological factors that shape people’s lives, and create the environment that they live in.

Extensive research over the past 30 years has shown that it is the weaker groups in society that suffer the worst from disasters: the poor (especially), the very young and the very old, women, the disabled, and those who are marginalized by race or caste. Those who are already at an economic or social disadvantage tend to be more likely to suffer during disasters.

N:B:

The question of society’s resilience and vulnerability is very important for understanding the impact of disasters, and making choices about how to intervene.

Vulnerability is more than just poverty, but the poor tend to be the most vulnerable. This is perhaps the most apparent in the economic pressures that force people to live in cheap but dangerous locations, such as flood plains and unstable hillsides. Notable example in this regard is the 1976 earthquake that struck Guatemala City, which killed 1,200 people and made 90,000 homeless. It is popularly called a ‘class quake’ because most of the victims lived in slum areas; many of their homes were in dangerous ravines which were the only places they could afford to live in. The rich, in better constructed houses and safer locations, were affected far less.
Another very visible cause of vulnerability is **environmental degradation**. In 1995, a World Bank publication estimated that 80% of the poor in Latin America, 60% of the poor in Asia and 50% of the poor in Africa lived on ‘marginal lands that are characterized by poor productivity and high vulnerability to natural degradation and natural disasters’. The human impact on the natural environment heightens the risk of disaster in many ways. For example, cutting down trees causes soil erosion and landslides, which in turn can silt up rivers and cause flooding downstream. Building on flood plains reduces the amount of ground surface that can absorb rainfall, and so rain water runs off much faster into rivers, putting pressure on river banks and thereby increasing the likelihood of flooding. Overgrazing and over-cultivation can lead to soils becoming exhausted, or to erosion and landslides.

### Box 1.2: Issues behind disasters:

The underlying factors contributing to vulnerability to disasters are less immediately visible. For example, one needs to consider not just the fact that people live in flimsy houses in hazardous locations, but why they live there, which could be the product of such forces as: **poverty** (itself the result of local, national and even global economic forces); **population growth**; **displacement due to economic development** (for example loss of smallholdings to commercial agriculture); **migration to towns and cities** (which has a variety of socio-economic causes); **legal/political issues**, such as lack of land rights; **discrimination**; **government macro-economic and other policies**; and other political features, such as the **failure of government and civil society institutions** to protect citizens.

As stated by Wisner (1994), the chain of causality, from root causes to local dangers, can be both long and complex, but by tracking it one can identify a ‘progression’ of vulnerability that builds up pressures on communities. These pressures can be released by taking measures to reduce vulnerability all along the causal chain. Even well-intended development programmes can increase vulnerability. For example, promoting heavily irrigated rice agriculture can lead to
the increased incidence of malaria because mosquitoes breed where there is standing water; building embankments for new roads and railway lines can block natural flood drainage channels.

**Critical reflection:**

What do you think is the relationship between ‘Disasters’ and ‘Development’? Look at the figure below where the vertical line represents disaster & development realm, and the horizontal line represents negative & positive effects of the two realms. What sort of relationships could be drawn from it?

![Figure 1: Relationship between Disaster and Development (source: UNDP/UNDRO Disaster Management Training Module, 1991)](image_url)
1.4 TERMS AND CONCEPTS

Understanding of disasters and its management requires a clear definition of terms and concepts related to hazard, vulnerability, and risk. Hence, for a better understanding of this module, the following section provides some concept clarification about these terms. The basic terms and concepts fall into three groups:

1. **Disaster terminology**: terms concerning the nature and elements of disaster.

2. **Disaster management terminology**: terms for different components of disaster management cycle.

3. **Disaster risk management terminology**: terms and concepts for different components of disaster risk management processes where ‘disaster risk reduction’ is the most common term often used in recent times.

Researchers and practitioners do not use these terms consistently and many definitions are academic and hence over-elaborate. This module follows the standard definitions of UN-ISDR.

### 1.4.1 DISASTER TERMINOLOGY

**Hazard**

A hazard can be defined as a potentially damaging physical event, phenomenon or human activity, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydro meteorological and biological) and/or induced by human processes (environmental degradation and technological hazards).

Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterized by its location, intensity and probability. Typical examples of hazards can be the...
absence of rainfall (leading to drought) or excess of rainfall (leading to flooding). Chemical manufacturing plants near settlements can also be source of hazards; similarly, inappropriate agricultural practices will, in the long run, lead to possible disasters such as loss of crops and famine. Hazards can either be a creation of humans or the environment. Although the former can more easily be planned for than the latter, in both cases the management of the impact of the hazard will remain the same.

**Vulnerability**

Vulnerability is a set of conditions and processes resulting from physical, social, economical and environmental factors, which increase the susceptibility of a community to the impact of hazards. It can comprise of physical, socio-economic, environmental and/or political factors that adversely affect the ability of communities to respond to events. According to Blaikie et al. (1994), vulnerability can be defined as the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of a hazard. Vulnerability can also be expressed as the degree of loss (for example, expressed as a percentage from 0 to 100) resulting from a potentially damaging phenomenon or hazard. It is therefore the extent to which a community will degrade when subjected to a specified set of hazardous conditions.

Vulnerabilities can be physical, social, or attitudinal and can be primary or secondary in nature. If there are positive factors, that increase the ability of people and the society they live in, to cope effectively with hazards, that increase their resilience, or that otherwise reduce their susceptibility, they are considered as capacities (capabilities and coping mechanisms).

**Risk**

The term risk is multidisciplinary and used in a variety of contexts. It can be defined as the probability of harmful consequences, or expected loss (of lives, people injured, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human induced hazards and vulnerable/capable conditions. Conventionally
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Risk is expressed by the equation Risk = Hazards x Vulnerability / Capacity. Risk is therefore the possibility that a particular hazard might exploit a particular vulnerability. It is the product of the possible damage caused by a hazard due to the vulnerability within a community. It should be noted that the effect of a hazard with a particular magnitude would affect communities differently. This is true due to the fact that capacity and coping mechanisms vary within and between communities. Poorer communities are usually more at risk than communities with reasonable capacity to cope.

Beyond expressing a probability of physical harm, it is crucial to appreciate that risks are always created or exist within social systems. It is important to consider the social contexts in which risks occur and that people therefore do not necessarily share the same perceptions of risk and their underlying causes. Two elements are essential in the formulation of risk: the probability of occurrence of a given threat (hazard); and the degree of susceptibility of the element (vulnerability).

Disaster

A disaster is a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community/society to cope using its own resources. Disasters can be sudden (flash floods) or progressive (drought). ‘Disasters’ can be called disasters if and only if they affect the way in which we live.

Given the above definition and concept of terms related to disaster, one can argue that there is nothing ‘natural’ about disasters. There are only natural hazards and they become disasters if they affect human beings to the extent of causing loss in lives and property. Therefore, a disaster is a function of the risk process. It results from the combination of hazards, conditions of vulnerability and insufficient capacity or measures to reduce the potential negative consequences of risk.
Disasters are the realized hazard risks, where as the term ‘disaster risk’ is a potential disaster resulting from the product of the combination of three elements-vulnerability, coping capacity and hazard. The following formula illustrates this interaction:

\[
\text{Disaster risk (R)} = \text{Vulnerability (V)} \times \text{Hazard (H)} / \text{Capacity (C)}
\]

1.4.2 DISASTER MANAGEMENT TERMINOLOGY: (OLDER TOOLS)

‘Disaster management’

This term is often used in a general sense, covering the implementation of preparedness, mitigation, emergency response and relief and recovery measures.

**Mitigation**

Mitigation refers to structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards. It can be also defined as any action taken to minimize the extent of a disaster or potential disaster. Mitigation can take place before, during or after a disaster, but the term is most often used to refer to actions against potential disasters. Mitigation measures are both physical or structural (such as flood defenses or strengthening buildings) and non-structural (such as training in disaster management, regulating land use and public education).

**Preparedness**

Preparedness refers to specific measures taken before disasters strike, usually to forecast or warn against them, take precautions when they threaten and arrange for the appropriate response (such as organising evacuation and stockpiling food supplies). Preparedness falls within the broader field of mitigation.
Prevention

Prevention refers to activities to provide outright avoidance of the adverse impact of hazards and related environmental, technological and biological disasters. Depending on social and technical feasibility and cost/benefit considerations, investing in preventive measures is justified in areas frequently affected by disasters. In the context of public awareness and education, prevention refers to changing attitude and behaviour towards a “culture of prevention”.

1.4.3 DISASTER RISK MANAGEMENT TERMINOLOGY: NEWER TOOLS

Disaster risk reduction (disaster reduction)

This refers to the systematic development and application of policies, strategies and practices to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impact of hazards, within the broad context of sustainable development.

The disaster risk reduction framework, as described in the 2002 ISDR review document, is composed of: risk awareness and assessment including hazard analysis and vulnerability/capacity analysis; knowledge development including education, training, research and information; public commitment and institutional frameworks, including organisational, policy, legislation and community action; application of measures including environmental management, land-use and urban planning, protection of critical facilities, application of science and technology, partnership and networking, and financial instruments; and early warning systems including forecasting, dissemination of warnings, preparedness measures and reaction capacities.
Disaster risk management

It refers to the systematic management of administrative decisions, organization, operational skills and responsibilities to apply policies, strategies and practices for disaster risk reduction. It can be also defined as a process through which disaster risk reduction activities are practically applied. It is an integrated approach to multisectoral and multidisciplinary planning, that aims at lessening the impacts of natural hazards and related environmental and technological threats. It is therefore a proactive approach that focuses on preparedness, mitigation, prediction/early warning actions that could reduce future impacts & lessen the need for government intervention in the future.

Box 1.3: Multidisciplinary nature of Disaster risk management

Disaster Risk Management as Discipline

Informed by

- Robust body of knowledge on disaster risks and how to manage and reduce them.
- The processes of disaster risk assessment/analysis are the basic for identifying and prioritizing management options

Integrated body of practice that includes:
- Systematic organisational approach to management of disaster risks
- Ethical principles and processes
- Developmental principles and processes around equity, sustainability and resilience

Hazard assessment/analysis

Hazard assessment refers to identification, studies and monitoring of any hazard to determine its potentiality, origin, characteristics and behaviour. It is therefore the interaction of the characteristics of a hazard in terms of the type of hazard, its projected intensity, space or physical location of onset, and its duration.

Vulnerability assessment/analysis

Vulnerability Assessment is the process of estimating the susceptibility of ‘elements at risk’ to various hazards and analyzing the causes behind their vulnerability. The assessment takes into account the physical, geographical, economic, social, political and psychological factors, which make some people more vulnerable to the dangers of a given hazard while others are relatively protected.

Risk assessment/analysis

This is a process to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability/capacity that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend.

The process of conducting a risk assessment is based on a review of both technical features of hazards such as their location, intensity, frequency, and probability, and also the analysis of the physical, social and economic dimensions of vulnerability, while taking particular account of the coping capabilities pertinent to the risk scenarios.

Risk treatment measures

This refers to disaster risk management countermeasures that can be developed based on the information obtained from the process of risk analysis (hazard, vulnerability, capacity analyses) and can be applied to avoid, reduce, transfer or retain the risk. Disaster risk treatment measures are commonly divided into ‘risk control’ and ‘risk finance’. Risk control is further
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broken down into ‘risk avoidance’ and ‘risk reduction,’ while ‘risk finance’ is composed of ‘risk transfer’ and ‘risk retention’.

1.5 DISASTER MYTHS

Myths about disasters are widespread and persistent, despite repeated experience to the contrary and the findings of social science research. They are often reinforced in the public mind by media coverage. Disaster myths are a significant problem, because they influence the way operational agencies think and act. Among the most prominent myths, as identified by Twigg (2004), are the following?

- Disasters are acts of God (which means that nothing can be done about them) or acts of nature (which means that the problem can be resolved by scientific or technical interventions alone).
- People are fatalistic about disasters and do not take action to protect themselves against future events.
- When a disaster strikes, people are helpless, passive, dependent victims incapable of carrying out even basic tasks. Therefore, they rely on help from aid agencies.
- People panic during disasters; they cannot be relied upon to react rationally at times of great danger.
- The chaos that follows disasters encourages many people to engage in anti-social behavior (particularly looting).
- External ‘experts’, with their advanced knowledge and technologies, are the main agents in risk reduction and disaster response.
- The situation will return to normal within a few months of the disaster, and support for rehabilitation need only be for the short term.

Critical reflection:

What are the implications of the above prominent disaster myths to disaster risk reduction and management?
Reference:


Coppola, D, 2007. Introduction to International Disaster Management.


CHAPTER 2: UNDERSTANDING HAZARDS

General description:
This chapter introduces different types of hazards and raises awareness about their key characteristics. Such awareness is useful in the process of hazard assessment.

Learning Objectives:
At the end of this session, the participants will be able to:

- define and identify types of hazards
- describe characteristics of hazards
- understand the process of hazard assessment

Key Concepts
A hazard is a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.

Hazards may be single, sequential or combined in their origin and effects. Hazards can also be narrowly confined to a locality or threaten entire regions. Hence, a hazard is a variable whose intensity and probability can differ by place.

Hazards can be characterized by their permanent and temporal features. Permanent features include nature, scope, intensity, extent, predictability and manageability of hazard occurrences.

Temporal characteristics of hazards include frequency, duration, speed of onset, and forewarning.

Hazards are commonly distinguished based on their nature and speed of onset.
2.1 WHAT ARE HAZARDS?

As defined by ISDR, a hazard refers to a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards are extreme natural events with a certain degree of probability of having adverse consequences. However, a distinction needs to be drawn between a real natural hazard and a socio-natural hazard. Given the complex set of influences this distinction is difficult to make, but it is useful in helping to define disaster risk management measures. Whereas with truly natural phenomena people exert no influence as regards their occurrence, socio-natural hazards are induced or aggravated by a combination of extreme natural events and human interventions in nature. Only a few hazards, earthquakes for example, occur as purely natural phenomena; most others, such as forest fires, floods and landslides, can come about with and without human intervention.

Critical reflection:

Dear participants, do you think natural hazards are inherently damaging events? Are there potentially damaging events that occur as purely natural phenomena?

Hazards can include latent conditions that may represent future threats and have different origins. This includes natural (geographic, hydro-meteorological and biological) process and/or processes induced by humans (environmental degradation and anthropogenic hazards). Hazards may be single, sequential or combined in their origin and effects. Hazards can also be narrowly confined to a locality or threaten entire regions. So a hazard is a variable whose intensity and probability can differ by place. This has a considerable influence on the levels of possible damage. The magnitude of the hazard, the probability of its occurrence, and the extent
and severity of its impact may vary. In many cases, these effects can be anticipated or estimated.

Furthermore, hazards are not static phenomena and hazard risk exposures change over time. Ideally, therefore, one should understand future changes in hazard risk over given periods: a ‘probabilistic’ hazards assessment, rather than a ‘normative’ one based on current conditions. This is particularly relevant to climate change, which may have a significant effect on the patterns and trends of natural hazards and disasters.

**N:B:**

Hazards can have positive as well as negative effects (e.g., floods deposit fertile sediments).

### 2.2. CHARACTERISTICS OF HAZARDS

Five basic characteristics can be used to describe most hazards:

- intensity (how big, fast, and powerful);
- frequency (the likelihood of a hazard causing an event of a given magnitude);
- extent (the area that a hazard may affect);
- time frame (warning time, duration, time of day, week, year);
- manageability (whether anything can be done about it).

For each hazard, these characteristics may mean different things. In flooding, for example, intensity might relate to height of water/river, flow rate and speed, whereas in an earthquake, intensity relates to the number and strength of earth tremors. Broadly speaking hazards can be characterized by their permanent and temporal features. Permanent features include nature, scope, intensity, extent, predictability and manageability of hazard occurrences.
2.2.1 Permanent characteristics of hazard occurrences

Nature

The nature of hazards describes the type of force associated with the hazard, understanding the forces one can determine the intensity and extent of hazard. Earthquakes, cyclones and volcanic activities are some of the forces that can cause disasters. Even though these forces are beyond the control of man, governments can develop policies and mechanisms to prepare for any eventualities to minimize the impact of such forces on societies.

In the case of man-made technological hazards and environmental degradation, the nature of the hazard relates to unplanned activities of human beings. In this regard, unlike natural hazards, these types of hazards are easier to plan for, and predict. This is because human beings have direct control over their outcome.

Intensity

Here the intensity of hazards describes how big, fast and powerful the hazard is; in other words the capacity or potential of destructive forces or the effect of the hazard on a community is described as its intensity. The stronger and longer the tremors of an earthquake are, the more the damage on community with high rise buildings will sustain. Understanding the intensity of the hazard therefore helps to determine its magnitude and possible impact on elements at risk. It also helps to determine the different levels of risk which the elements at risk are under. In this regard, certain acceptable parameters can be established for effective contingency planning.

The intensity of a natural hazard is quantified in terms of the magnitude of occurrence, which is an event parameter. It can also be done in terms of the effect of the occurrence at a particular
location. This is called a **site parameter**. Both parameters may be combined in certain situations. Parameters for selected hazards are listed below.

Table 2.1: Event and Site Parameters of Selected Hazards

<table>
<thead>
<tr>
<th>Natural Hazard</th>
<th>Event Parameter</th>
<th>Site Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclone</td>
<td>Wind speed-km/h</td>
<td>Area affected</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Magnitude-Richter Scale</td>
<td>Intensity-Modified Mercalli Scale</td>
</tr>
<tr>
<td>Flood</td>
<td>Area flooded-km²; Volume of water-m³; Speed</td>
<td>Depth of flood water-meters</td>
</tr>
<tr>
<td>Landslide</td>
<td>Volume of material dislodged; Area affected</td>
<td>Ground displacement-meters</td>
</tr>
<tr>
<td>Tsunami</td>
<td>Height of wave crest</td>
<td>Depth of flood water</td>
</tr>
<tr>
<td>Volcano</td>
<td>Eruption size and duration</td>
<td>Ash fall-meter; Lava flow-area</td>
</tr>
</tbody>
</table>

Although the term duration, time points of initiation and termination of drought, and the areal coverage have been defined in a nearly consistent manner in the literature, considerable disagreement exists in defining the term intensity/severity. However, intensity/severity has been expressed through some indices.

Drought indices assimilate thousands of bits of data on rainfall, snowpack, stream flow, and other water supply indicators into a comprehensible big picture. A drought index value is therefore typically a single number, far more useful than raw data for decision making. There are several indices that measure how much precipitation for a given period of time has deviated from historically established norms. Although none of the major indices is inherently superior to the rest in all circumstances, some indices are better suited than others for certain uses.
Box 2.1: Standardized Precipitation Index (SPI): a measure of drought intensity

The World Meteorological Organization (WMO) adopted the Standardized Precipitation Index (SPI) in 2009 as a global standard to measure meteorological droughts, via the ‘Lincoln Declaration on Drought Indices’.

The SPI calculation for any location is based on the long-term precipitation record for a desired period. This long-term record is fitted to a probability distribution, which is then transformed into a normal distribution so that the mean SPI for the location and desired period is zero.

Positive SPI values indicate greater than median precipitation, and negative values indicate less than median precipitation. A drought event occurs any time the SPI is continuously negative and reaches an intensity less than or equal to -1.0. The event ends when the SPI becomes positive.

Each drought event has a duration defined by its beginning and end, and intensity for each month that the event lasts. The sum of the SPI's for all the months within a drought event is the drought magnitude.

Extent

The geographical area that a hazard may affect is described as its extent. Hazards can affect specific locality or entire regions. Thus, its intensity and probability can vary from place to place. This has a considerable influence on the levels of possible damage triggered by a hazard. However extent of the hazard or the level of disaster associated to a hazard is not only determined by the nature and intensity of the hazard. The extent of a hazard can also be determined by vulnerability of the element at risk (community, city etc). For example, one area might have adequate wetlands to absorb the masses of water in the case of a flood. However,
in urban areas, impermeable surfaces might exacerbate the intensity of the hazard due to increasing range of impact.

Many hazards are only to be found in well defined physical locations. Monsoon-type storms are found within or close to the tropics; inundation-type floods occur in low-lying areas, often adjacent to rivers and lakes; flash floods occur generally in narrow restricted water-ways on or close to steep slopes and draining specific watershed systems. Volcano and earthquake zones are found along the interstices of tectonic plates. Areas prone to drought are well defined. Hazards which are biological in origin are less well geographically defined, but many crop pests (e.g. locusts) are found in only specific areas, and diseases such as malaria are only found where conditions favour the breeding of the mosquito vector which is dictated by availability of lying water and temperature.

**Scope**

The scope of a hazard is the range(s) of impact on communities or its sectoral extent. The scope is determined by the community and their ability to deal with the nature, intensity and extent of the hazard. Assume flood ‘A’ has a particular nature, intensity and extent and occurs in a well-developed urban area. This area might have all the relevant infrastructure and forewarning to deal with the nature, intensity, extent of the hazard. The same flood ‘A’ occurring in a different community (e.g. rural community) will have a different scope. The elements at risk will be much more and the intensity will be exacerbated. The scope of a hazard can also be different due to its secondary consequences; for example, if flood ‘A’ triggers fire, the scope of the hazard changes dramatically given the contexts of the two areas. The rural community might not be affected to the extent of loosing lives and property as the urban area might be, due to high population and infrastructure density.

**Predictability**
Predictability is the time frame given for the hazard to build up and give indicators/signs that could be used as warning time, its duration, time of day, week or year. Hazard predictability is determined by the physical or temporal properties of the hazard. The nature of the hazard provides us with valuable historical information that can be used in order to predict its consequences. This predictability or forewarning of hazards contributes to the mitigation and prevention of the impact of the hazard. Weather patterns can be predicted in sufficient time frame for communities to be warned of the hazard and get prepared. Droughts, cyclones are some of the hazards communities could prepare for.

Manageability

This describes a country’s/community/family’s capacity and resourcefulness as to whether anything can be done about the hazard. Manageability will also depend on the perception of risk and the determination to take appropriate measures. As the intensity, extent and scope of the hazard increase and its predictability decrease, the manageability of the hazard is influenced. Manageability in this regard relates well to the human activity of instituting measures to deal with the hazard and prevent a disaster. The existing resources and capacity to cope therefore play an important role. The level of risk associated to the hazard is therefore determined by the degree of its manageability.

2.2.2 TEMPORAL CHARACTERISTICS OF HAZARDS

Frequency

It is the likelihood of a hazard causing a damaging event of a given magnitude. It describes as to how often the event recurs. The higher the frequency the greater the perception of risk will be throughout the community. It is common to use the words “highly likely” “likely”, “possible”, and “unlikely” etc. to describe the frequency of hazards. These are related to a time period. A variety of different types of information can be used to perform frequency analysis. Historical recorded data related to the occurrences of past hazards is one of the most common and
widely used sources of information. Certain patterns in relation to the characteristics of the hazard can be identified and fairly accurate deductions can be made. In determining the frequency of the hazard, it is possible to determine the likelihood of the next hazardous event as well as its time and space variables. An accurate assessment and analysis of the frequency of occurrences of hazards helps to provide us with early warning information. Much of the current weather predictions are based on frequency analysis. The frequency of hazards depends on its seasonality. Natural hazards tend to follow seasonal patterns. Flood in the rainy season occurs more frequently than in the dry season.

However, current changes in global weather patterns are increasingly making it more difficult to accurately determine hazard frequency. The presence of El Nino or La Nina, global warming, the greenhouse effect or the melting of the polar ice, ensures that the determination of the frequency of different hydro-meteorological hazards have become less accurate.

**Duration**

This describes the hazard’s expected time of lasting impact on a community. Different hazards with different characteristics have different durations. The impact however will be very much influenced by the vulnerability of the elements at risk. Slow onset hazards will have longer durations e.g. drought, while hazards with more rapid onset might have short duration but with greater impact e.g. cyclones or earthquakes. The duration of the hazard relates quite well to its extent of damage and severity. For example, a drought that occurs during critical periods of agricultural activities has quite significant impact than that of a drought which occurs in other periods. Hence, given the seasonality of drought hazard and its frequency, determining drought duration helps for effective drought preparedness and emergency planning.
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**Speed of onset**

The speed of onset of a hazard describes the rapidity of arrival of its impact. The higher the speed is, (with little preparation) the greater the impact. Speed of onset relates to mitigation and prevention measures. It is likely to lessen the extent of the hazard, if we could determine the rapidity of arrival of its impact. Understanding the frequency and duration of hazards helps to determine the possible speed of onset. If we are able to determine the speed, there will be an opportunity to forewarn in advance and take preventive actions. The greater the speed of onset, the shorter the forewarning and the less time for reaction is available.

**Forewarning**

Forewarning or early warning is the period of time between the identification or warning of a hazard and its actual impact. The speed of onset will determine the period of warning. The shorter the forewarning, the less time people will have to prepare themselves and the more the damage will be. The warning period allows preventing loss of lives and property by removing the elements at risk from the impact area. There are two critical time frames of hazards that should be considered for effective emergency response. The first is the warning time that refers to the time-lag between detecting or predicting the hazard occurrence and disseminating information about it. The second time frame is the length of the lead time (the period between receipt of the warning and action being taken).

**N:B:**

The priority that we allocate to a hazard is determined by its temporal and permanent characteristics. Understanding both characteristics of hazards is critical for effective hazard mitigation and preparedness planning.
2.3 CLASSIFICATION OF HAZARDS

Hazards are commonly distinguished based on their nature and speed of onset.

2.3.1 ‘RAPID-ONSET AND SLOW-ONSET HAZARDS’

‘Rapid-onset’ hazards include earthquakes, volcanoes, fires, landslides, cyclones, tsunamis, flash flooding and some kinds of epidemic. Some of these hazards afford very limited or virtually no opportunity for warning before their impacts are felt. This makes it all the more important not only to establish accurate and well functioning early warning systems where warning is feasible (as in the case of cyclones and many floods, for example), but also to build resources to reduce vulnerability, enhance coping capacity and prepare for disaster response as part of development practice.

‘Slow-onset’ hazards are those that build up over weeks, months or even years. Drought leading to food insecurity is the most common, but some flood events might also be considered as slow onset. If early indicators of a potential crisis are detected then warning can be a key tool in building resilience, as recognised in the large investment in food security early warning systems. Many people consider HIV/AIDS to be a slow-onset disaster, dwarfing all others in the magnitude and breadth of its impacts. This is an issue which has been the focus of many seminal policy papers.

2.3.2 ‘EXOGENOUS AND ENDOGENOUS HAZARDS’

A distinction is also often made between hazards that are exogenous and endogenous to a society. This refers to the extent of their social origins and is relevant to that society’s scope for action to minimise the hazard. Hazards exogenous to one society can be endogenous to another or on a wider social scale. Many hazards such as industrial air or water pollution or floods cross international borders – for example the Mozambique floods of 2000 were exacerbated by the opening of upstream dams in neighboring countries. ‘Natural’ hazards tend
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to be conceived as exogenous, but many are at least partly endogenous phenomena – they are the product of the joint evolution of coupled human and physical systems and so are partly rooted in historical and contemporary development planning. The disasters that result from them always have an endogenous element because they also reflect levels of vulnerability. Based on the nature of hazards, ISDR (2002) chooses to classify hazards into three categories:

- Natural hazards
- Technological hazards
- Environmental degradation

**Natural hazards:**

They are natural processes or phenomena occurring in the biosphere that may constitute a damaging event. Natural hazards have their origin in natural processes over which people have little or no control. People can, however, avoid or at least minimize the impact of natural hazards upon the built environment; they can stop such events from resulting in disasters. Natural hazards can be classified as geological, hydro-meteorological or biological. The following table provides phenomena of each of the types of natural hazards:

<table>
<thead>
<tr>
<th>Origin</th>
<th>Phenomena/examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Geological hazards:</strong></td>
<td>• Earthquakes, tsunamis;</td>
</tr>
<tr>
<td>Natural earth processes</td>
<td>• Volcanic activity and emissions;</td>
</tr>
<tr>
<td>or phenomena in the</td>
<td>• Mass movements i.e.: landslides, rockslides, rockfall, liquefaction, submarine</td>
</tr>
<tr>
<td>biosphere, which include</td>
<td>slides;</td>
</tr>
<tr>
<td>geological, neotectonic,</td>
<td>• Subsidence, surface collapse, geological fault activity.</td>
</tr>
<tr>
<td>geophysical, geo-</td>
<td></td>
</tr>
<tr>
<td>morphological,</td>
<td></td>
</tr>
<tr>
<td>geotechnical and</td>
<td></td>
</tr>
<tr>
<td>hydro-geological nature.</td>
<td></td>
</tr>
<tr>
<td>**Hydro-meteorological</td>
<td>• Floods, debris and mud flows;</td>
</tr>
<tr>
<td>hazards:**</td>
<td>• Tropical cyclones, storm surges, thunder/hailstorms, rain and wind</td>
</tr>
</tbody>
</table>

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### Natural processes or phenomena of atmospheric, hydrological or oceanographic nature.
- storms, blizzards and other severe storms;
- Drought, desertification, wild land fires, heat waves, sand or dust storms;
- Permafrost, snow avalanches.

### Biological hazards:
- Processes of organic origin or those conveyed by biological vectors, including exposure to pathogenic micro-organisms, toxins and bioactive substances
- Outbreaks of epidemic diseases,
- plant or animal contagion, and
- extensive infestations.

### Human-made hazards:
These are the consequences of human activities which may cause loss of life or injury, damage to property, social and economical disruption or environmental degradation. Examples of human-made hazards include: *technological hazards* arising from industrial accidents, dangerous procedures and infrastructure failures. Technological hazards could lead to industrial pollution through leakage of nuclear or toxic wastes, dam failures causing floods, industrial accidents causing fires, explosions and leakages, among others. Environmental degradation is partly due to processes induced by human behaviour and activities in a way (sometimes combined with natural hazards) that damages the natural resource base or adversely alters natural processes or ecosystems.

Table 2.2: types of human-made hazards

<table>
<thead>
<tr>
<th>Origin</th>
<th>Phenomena/examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technological hazards:</strong></td>
<td>• industrial pollution,</td>
</tr>
<tr>
<td>Danger originating from</td>
<td>• nuclear activities and radioactivity,</td>
</tr>
<tr>
<td>technological or industrial</td>
<td>• toxic wastes,</td>
</tr>
<tr>
<td>accidents, dangerous</td>
<td>• dam failures,</td>
</tr>
<tr>
<td>procedures, infrastructure</td>
<td></td>
</tr>
<tr>
<td>failures or certain</td>
<td></td>
</tr>
<tr>
<td>human activities, which</td>
<td></td>
</tr>
<tr>
<td>may cause the loss of life</td>
<td></td>
</tr>
<tr>
<td>Injury, property damage, social and economic disruption or environmental degradation. Sometimes referred to as anthropogenic hazards.</td>
<td>• Transport, industrial or technological accidents (explosions, fires, spills)</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>Environmental degradation:</strong> Processes induced by human behaviour and activities (sometimes combined with natural hazards), that damage the natural resource base or adversely alter natural processes or ecosystems. Potential effects are varied and may contribute to an increase in vulnerability and the frequency and intensity of natural hazards.</td>
<td>• Land degradation, • Deforestation, • Desertification, • Wildland fires, • Loss of biodiversity, land, water and air pollution, • Climate change, sea level rise, ozone depletion.</td>
</tr>
</tbody>
</table>

### 2.4 HAZARD ASSESSMENT APPROACHES

The process of collecting information related to the nature and characteristics of hazards is called hazard assessment. The process of hazard assessment depends on the following types and sources of information:

A. Available scientific information, including geologic, geomorphic, and soil maps; climate and hydrological data; and topographic maps, aerial photographs, and satellite imagery.

B. Historical information, both written reports and oral accounts from long-term residents. These may include myths and legends.

For assessment of most hazards, one cannot expect complete data required to carry out a comprehensive assessment. Depending on the situation, various assessment approaches are used with obvious variations in the degree of accuracy. There are four types of hazard assessment approaches: quantitative, qualitative, deterministic and probabilistic.

1. **Quantitative approach**

Here mathematical functions are used to denote relationships between variables considered to quantify the hazard. Numerical data can be fed in to assess the impact of the hazard event. An example is the probable flood that a particular rainfall could cause within a watershed area.
Flood dimensions such as depth of flood and area of inundation would depend on the volume of water that flows into the stream. Surface run-off, soil permeability, vegetation cover etc. would determine this. The empirical data collected from historical records as well as theoretical data from basic principles of physics are used to derive the relationship between variables.

The mathematical expression so derived could be used to forecast future events. However, quantitative assessment may not be possible for all hazard events.

2. **Qualitative approach**

This method uses ranking such as ‘high’, ‘moderate’ and ‘low’ to assess a hazard event. Where there is a lack of sufficient data for quantitative evaluation, or where certain variables cannot be expressed numerically, this qualitative ranking may be appropriate to take hazard mitigation decisions.

3. **Deterministic approach**

A past event is selected and its associated characteristics and the consequences are described. Past impact data can be combined with current conditions and possible exposure levels and impact could be determined. This would be adequate to visualize the recurrence of an event for community awareness but leaves room for inaccuracies.

4. **Probabilistic approach**

After identifying the hazards that affect communities and assessment of the impacts from those hazards, a probability analysis is undertaken. It provides an estimate of the probability of each hazard affecting an area or region. Probability for each hazard may be categorized as ‘high’, ‘moderate’ or ‘low’. Probability of occurrence can be calculated through research on past events.
2.5 COMPONENTS OF HAZARD ASSESSMENT PROCESS

Hazard assessment is the process of identifying and assessing the relative properties or characteristics and direct effects of hazards with reference to time. It involves identifying, describing/profiling, ranking or measuring and mapping hazards.

2.5.1 HAZARD IDENTIFICATION

This refers to determining which hazard is prevalent in an area and which are more serious and impending in their effects to a community. The hazards are prioritized on an agreed set of criteria for a particular area. Hazard identification is not straightforward. Because of people’s different perceptions of risk, one needs to seek the views of a number of people in the community. It is best undertaken by a group of people with expertise in the areas of work and a commitment to the safety of the area.

Box 2.2: Questions to ask during hazard assessment

If you are living in an area exposed to multiple hazards, for each hazard, ask yourself the following questions and try to answer them. The answers are usually based on past experience of hazard events. They may be recorded or may be gathered through interviews. They could give you a reasonable indication of the threat posed by the hazard for the area you live in.

- Could this hazard affect the area you live in?
- Is this hazard a significant threat there?
- How often does it pose a threat? E.g. Once every 5 years or 10 years
- What is a close estimate of the population size that could be affected by this hazard event? Give a rating. Very high? High? Medium? Low? Very low?
- What is the expected duration of the hazard?
- What is the expected damage from the hazard event? Give a rating. Very high? High? Medium? Low? Very low?
2.5.2 HAZARD RANKING/PRIORITIZING

Hazard ranking through a group technique:

This is a quick method to determine people’s perception of the most serious hazards.

- Get a group of people and ask them to write the 10 hazards faced in the area.
- Rank the hazards into the level of seriousness by ranking them into “high” “medium” and “low”.
- Each person should then say what he or she has written down (without the ranking) and answers should be recorded on a blackboard or paper.

A table of ranking is then produced as the number of hazards are ranked based on the number of support coming from the participants. Once the hazards are ranked, they should be prioritized in order to focus on the more serious ones and take mitigation measures. The lack of resources and capacity for the management of hazards, vulnerability, and emergencies is a common limitation which justifies the need for prioritizing hazards. Hence, with the available resources, communities are forced to consider the serious hazards only if they are to take preventive measures. Each community must decide which hazards are important to deal with in a specific area, time and the degree of intervention. In addition to the quick group technique, there are many other ways to determine the priority. For this training purpose the following characteristics of hazards such as probability, magnitude, and intensity of potential impact.
areas, scope, predictability and manageability can be used to prioritize hazards. The following table illustrates how hazards can be prioritized based on a scale of 1-5 (1 being minimal and 5 being maximum) that determines the frequency, area of impact, and potential magnitude of the hazard. Hence, given \((\text{frequency} + \text{areal impact}) \times \text{potential damage magnitude} = \text{total score}\)

Table 2.3: Hazard prioritization

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Frequency</th>
<th>+Areal impact</th>
<th>xMagnitude</th>
<th>=Total</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>28</td>
<td>3</td>
</tr>
<tr>
<td>Wild fire</td>
<td>3</td>
<td>4</td>
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</table>

By using the above example we can gain insights about the hazard that poses the most severe threat to a given area. The priority hazard should therefore enjoy the most attention. The prioritization of hazards should also serve to inform other government functionaries in order for them to engage in risk reduction activities.
2.5.3 HAZARD MAPPING

Hazard mapping is the representation of the hazards faced by a community in a geographical area on a manually prepared map (improvised) or a technical map using Global Information System (GIS).

Using a technical map or a manually prepared one, the geographically important sites are marked; these include towns, villages, forest area, plains or rivers, landslides areas, water holes etc. On top of these, using different colour markings, one could also show the areas exposed to an identified hazard. The next step is to mark those communities or towns that are likely to face an impact from some of the hazards. The map could also be used to indicate the vulnerability of people of the town by marking the zones with the highest density of population, the site of important facilities, where the good and bad roads are, or in a bigger scale map that indicates where the poor quarters are located, and other vulnerability indicators.

Probability of hazard occurrence varies from place to place. The use of mapping to synthesize data on natural hazards and to combine these with socioeconomic data facilitates analysis. It improves communications among participants in the hazard management process and between planners and decision-makers. Two important techniques in use are

- Multiple hazard mapping and
- Critical facilities mapping

1. Multiple Hazard Mapping (MHM)

This is usually carried out with new development in mind. Valuable information on individual natural hazards in a study area may appear on maps with varying scales, coverage, and detail, but these maps are difficult to use in risk analyses due to the inability to conveniently overlay them on each other for study. Information from several of them can be combined in a single
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map to give a composite picture of the *magnitude, frequency, and area of effect of all the natural hazards.*

**Box 2.3: the scale of the hazard map matters!**

- Regional scale hazard mapping uses 1:100,000 to 1:250,000. These are useful during planning stages of regional development.

- Urban land use planners may need medium scale hazard maps of 1:10,000 to 1:25,000.

- Site investigation for infrastructure projects may require large-scale hazard maps of 1:1,000 to 1:5,000.

The multiple hazard map (MHM) also called a composite, synthesis, or overlay map, is an excellent tool for fomenting an awareness about natural hazards and for analyzing vulnerability and risk, especially when combined with the mapping of critical facilities. Its benefits include the following:

- Characteristics of the natural phenomena and their possible impacts can be synthesized from different sources and placed on a single map.

- It can call attention to hazards that may trigger others (as earthquakes or volcanic eruptions trigger landslides) or exacerbate their effects.

- A more precise view of the effects of natural phenomena on a particular area can be obtained. Common mitigation techniques can be recommended for the same portion of the study area.

- Sub-areas requiring more information, additional assessments, or specific hazard-reduction techniques can be identified.

- Land-use decisions can be based on all hazard considerations simultaneously.
The use of a multiple hazard map also has several implications in emergency preparedness planning:

- It provides a more equitable basis for allocating disaster-planning funds.
- It stimulates the use of more efficient, integrated emergency preparedness response and recovery procedures.
- It promotes the creation of cooperative agreements to involve all relevant agencies and interested groups.

The base map upon which to place all the information is the first consideration. It is usually selected during the preliminary mission. If at all possible, it is best to use an existing map or controlled photograph rather than go through the difficult and time-consuming process of creating a base map from scratch.

The scale used for an MHM depends on the hazard information to be shown, availability of funds and the scale of the base map. If a choice of scales is available, then the following factors should be considered:

- Number of hazards to be shown.
- Hazard elements to be shown
- Range of relative severity of hazards to be shown.
- Area to be covered.
- Proposed uses of the map.

Much hazard information will be in forms other than maps, and is not readily understandable by laymen. It must be "translated" for planners and decision-makers and placed on maps. The
information should explain how a hazard may adversely affect life, property, or socioeconomic activities, and must therefore include location, likelihood of occurrence (return period), and severity. If some of this information is missing, the planning team must decide whether it is feasible to fill the gaps. Development and investment decisions made in the absence of these data should be noted. Despite the importance of multiple hazard maps in the integrated development planning process, planners and decision-makers must remember that the credibility, accuracy, and content of an MHM are no better than the individual hazard information from which it was compiled. Furthermore, since MHM contains no new information - it is merely a clearer presentation of information previously compiled - the clarity and simplicity of the map is the key to its utility.

2. Critical Facilities Mapping (CFM)

This is carried out for development within existing infrastructure in mind. The term "critical facilities" refers to all man-made structures or other improvements whose function, size, service area, or uniqueness gives them the potential to cause serious bodily harm, extensive property damage, or disruption of vital socioeconomic activities if they are destroyed or damaged or if their services are repeatedly interrupted. The primary purpose of a critical facilities map (CFM) is to convey clearly and accurately to planners and decision-makers the location, capacity, and service area of critical facilities. An extensive number of such facilities can be presented at the same time. Also, when combined with a multiple hazard map, a CFM can show which areas require more information, which ones require different hazard reduction techniques, and which need immediate attention when a hazardous event occurs. Some of the benefits of a CFM are:

- The uniqueness of service of facilities in the area (or lack of it) is made clear.
- Facilities that may require upgrading and expansion are identified.
- The impact of potential development on existing infrastructure can be assessed before a project is implemented.
- Any need for more (or better) hazard assessment becomes apparent
3. Combining critical facilities maps and multiple hazard maps

There are many advantages in combining a CFM, with a MHM, and integrating both into the development planning process. For example, if a critical facility is found to be in a hazardous area, planners and decision-makers are alerted to the fact that in the future it may confront serious problems. Its equipment, use and condition can then be analyzed to evaluate its vulnerability. If appropriate techniques to reduce any vulnerability are incorporated into each stage of the planning process, social and economic disasters can be avoided or substantially lessened. Avoiding hazardous areas, designing for resistance, or operating with minimal exposure, can make new critical facilities less vulnerable. Mitigation strategies for existing critical facilities include relocation, strengthening, retrofitting, and adding redundancy, revising operations, and adopting emergency preparedness, response, and recovery programs. The benefits obtained by combining a CFM and an MHM include:

- Project planners and decision-makers are made aware of hazards to existing and proposed critical facilities prior to project implementation.
- The extent to which new development can be affected by the failure or disruption of existing critical facilities as a consequence of a natural event can be determined.
- More realistic benefit-cost ratios for new development are possible.
- Sub-areas requiring different assessments, emergency preparedness, immediate recovery, or specific vulnerability reduction techniques can be identified.

2.6 OUTCOMES OF THE HAZARD ASSESSMENT PROCESS

The outcome is natural hazards information, which denotes the presence and effect of natural phenomena. Hazard assessment is the first step for hazard mitigation planning. It prioritizes hazards so that a community or a government may use discretion to plan and implement hazard mitigation action. This information should ideally include the location, severity, frequency, and probability of the occurrence of a hazardous event. Location is the easiest for
planners to find; the rest can often be obtained from sectoral agencies, natural hazard research and monitoring centers and integrated development planning studies. It could have information on natural ecosystems (e.g., slopes and slope stability, river flow capacity, vegetation cover), which provides the basis for estimating the effect natural hazards can have on these systems. Change in the ecosystem may create, modify, accelerate, and/or retard the occurrence of natural events. Large-scale data describing lifeline infrastructure and human settlements for example, are critical elements for preparing vulnerability assessments and for initiating disaster preparedness and response activities.

**Box 2.4: Key points that needs to be considered during the process of hazard assessment**

In identifying and prioritizing and mapping of the hazards, which threaten the community, the following points have to be considered:

- Some hazards also cause secondary hazards. Example, earthquakes cause landslides; drought might cause epidemics and pest infestation; floods might carry out pollutants and cause epidemics; etc. in such instances, one should consider the main force of primary hazard.
- Although hazard assessment is based on past hazard patterns, we should not forget to look at possible disaster threats that are new for the community and are likely to happen. There are an increasing number of threats due to changes in natural, economical, social and political trends. Threats unnoticed before, simply because nothing was exposed to them, can easily turn into major problems that no one had predicted (ethnic conflicts, industrial hazards, AIDS).
- We should also consider the various intensities which each hazard may have.
- The rarer the occurrence of a hazard in a given area, the less historical information there is to work with. Therefore, other sources should be consulted to provide more reliable information about their prediction and possible behavior.
A community interacts with its environment and hazards ... Thus changes in the environment caused by the community alter the hazard in the area, and the changed hazards may then have effects on the environment, the community and its vulnerability.

References:


CHAPTER 3: UNDERSTANDING VULNERABILITY

General description:
This chapter introduces conceptual and theory frameworks/approaches in understanding vulnerability and raises awareness about the key characteristics of vulnerability and the major factors driving vulnerability. Such awareness is useful in the process of risk assessment.

Learning Objectives:
At the end of this chapter, the participants should be able to:

- Define vulnerability
- Understand, explain and criticize the different vulnerability frameworks
- Describe various dimensions of vulnerability
- Understand the process of vulnerability assessment

Key concepts:

- Vulnerability can be defined as ‘the characteristics of a person or group and their situation that influences their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard’.
- Vulnerability can also be defined as ‘the extent to which a structure or service is likely to be damaged or disrupted by a hazard event.
- There are always two key components of vulnerability: An external dimension relating to exposure to shocks, stresses and risks; and an internal dimension of ‘defenselessness' or lack of a means to cope without damaging loss.
- Vulnerability can be understood in different contexts such as disaster risk, poverty, food security, and climate change.
3.1 WHAT IS VULNERABILITY?

Vulnerability is a condition or a predisposition. It applies to individuals, groups of individuals or communities, but it can be also used when referring to physical structures or the environment in general. Vulnerability can be defined as ‘the characteristics of a person or group and their situation that influences their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard’.

In this context, vulnerability is viewed as a human dimension – compared to -

- Buildings are ‘susceptible/unsafe’........vulnerability as physical dimension
- Economies are ‘fragile’..... vulnerability as structural dimension
- Unstable slopes are ‘hazardous’..... vulnerability as physical dimension

Hence, in the above definition social characteristics are the key determinants of vulnerability – especially, gender, age, health status, ethnicity or race, socioeconomic status. This social characteristic represents human dimensions of vulnerability in which the elderly, women, children, the disabled, and the poor are generally recognized as the most vulnerable groups to the impacts of disasters.

N:B:

It does not mean that the most common vulnerable groups (such as elderly, women, disabled and children) are helpless victims; rather it means they require special attention particularly during emergency response and recovery.

Vulnerability can also be defined as ‘the extent to which a structure or service is likely to be damaged or disrupted by a hazard event. In this regard vulnerability is viewed as structural or physical dimension. Community vulnerability, therefore, exists when elements at risk are in the path or area of the hazard and are susceptible to damage by it.
Generally, vulnerability describes two aspects of the subject (i.e. an individual, family, community, structures or services etc) in terms of susceptibility and resilience. There are some differences in application:

- **Susceptibility**: Proximity and exposure to an event. It is the potential to incur harm or avoid loss.
- **Resilience**: Access to resources and capacities which determine the ability to recover from the impacts of a hazard event.

1. **Susceptibility**

It is the fact of being exposed. One can be susceptible but not vulnerable, e.g. a landslide is threatening a house but the owners have built a wall to protect it and to divert the landslide. Susceptibility is easy to assess. For example communities located near the river are more vulnerable to flooding than those located far away from the river. Hence, proximity to the river determines the level of vulnerability to flooding that the communities face in terms of exposure which is the state of being physically affected from a hazard. Researchers differentiate between voluntary and involuntary exposure to hazards. Examples of involuntary exposure include air pollution (as we must breathe ambient air), toxic contamination of food (as we must eat), and water pollution (as we have to drink). We do, on the other hand, have a greater choice over where we live and what activities we engage in (living in coastal or seismically active zones is to some extent voluntary; smoking and exposing yourself to the threat of cancer is definitely voluntary).

2. **Resilience**

It is the ability to adjust and recover. For example, the owners of a house threatened by a landslide but have a second house in town could reside there during the rainy season. One can be susceptible, but if he/she is resilient, he/she may not be vulnerable. Resilience has many components: it implies access to resources, individual skills, beliefs, etc. Compared to susceptibility, it is more difficult to assess.
Most Middle Eastern countries are in deserts. But their water supply system helps them not to be exposed to drought conditions in normal life. Hence, being located in moisture deficient areas (high exposure to drought risk) does not necessarily mean Middle Eastern countries are more vulnerable to the impacts of drought than those who live in low drought exposure areas. In addition, within communities with similar proximity to the source of potentially damaging events, individuals or families might need different recovery periods to restore the previous condition after a disaster event. For example, households with diversified livelihood sources and access to external assistance could recover faster from the debilitating effects of a disaster than those who depend on a single livelihood source and have limited access to resources and external assistance (limited capacity to respond and recover from the impacts of a disaster). Hence, the level of vulnerability to the impacts of a disaster is also determined by the capacity of individuals or families and livelihood systems to absorb and recover quickly from the impacts of disasters.

Therefore, if susceptibility is very low and resilience is very high, one has minimum vulnerability. For example, take a displaced population in a refugee camp. Susceptibility to measles is very high. If all Children are immunized however, resilience is high, and the vulnerability would be low. When Susceptibility is high and resilience very low, one has maximum vulnerability. If the children are not immunized, resilience is very low and the vulnerability is high.

Capacity is also reflected in the preparedness of the community to face a hazard event. Well prepared community against a potential hazard occurrence is less vulnerable to its impacts than those who are not prepared.

**Critical reflection:**

Dear participants, what do you think are the key characteristics of drought resilient and drought vulnerable society?
3.2 VULNERABILITY FRAMEWORKS

i. Vulnerability in the context of disaster risk

In the context of contemporary approaches to disaster risk, vulnerability has been defined as the inherent ‘conditions resulting from physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards’ (UNISDR 2004). Despite general agreements about the contributions made by vulnerability, there are significant differences in the conceptual frameworks/approaches used to describe vulnerability. Two of the most influential frameworks in understanding vulnerability in the disaster risk field are:

- The Pressure and Release model (PAR model) which was developed by Blakie et al. (1994) and further elaborated by Wisner et al. (2004), and

a. The Pressure and Release model (PAR model)

Wisner et al. (2004) interpret vulnerability as ‘the characteristics of an individual, population or organization and their situation that influences their capacity to anticipate, cope with, resist and recover from the impacts of hazards’. The basis of the framework is that a disaster is the joint result of two opposing forces -- those that generate vulnerability on the one side, and the hazard event on the other side.

In the PAR model, vulnerability can be conceptualized as the outcome of a progression from root cause through dynamic pressures which are processes and activities that transform the effects of root causes into unsafe conditions (see figure 2).

Hence, in the model disaster is the intersection of two opposing forces aggravated by dynamic pressures. These forces are those processes generating vulnerability on the one hand and natural hazard events/processes on the other hand. The model makes particular focus on
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processes that generate vulnerability through three sets of links with increasing levels of specificity:

- Root causes
- Dynamic pressures
- Unsafe conditions

**Root causes:** refers to Inter-related set of widespread and general processes in society and the world economy that are often distant spatially, temporally and ideologically from those the most at-risk. The most important decisive causes are economic, demographic and political processes that affect allocation and distribution of resources particularly concerned with dysfunction of the state and exercise/distribution of power.

**Dynamic pressures:** are processes and activities that ‘translate’ effects of root causes temporally and spatially into ‘unsafe conditions’.

- E.g. rapid urbanization, violent conflict, foreign debt and structural adjustment programmes, rural-urban migration

**Unsafe conditions:** are specific forms in which the vulnerability of a population is expressed in time and space in conjunction with a hazard. Unsafe conditions may be either **fragile physical conditions** (disaster-prone locations, unsafe buildings, unsafe infrastructure etc.) or **fragile local economies** (livestock at risk, low-income levels, low health status etc.).
Underlying root causes of a disaster scenario

Let us consider a scenario. Population expansion leads to inadequate housing and land needs. Prices of urban land appreciate. Low-income people may not be able to afford it. Rural–urban migration adds more pressure. There is thus expansion of urban areas outwards. The result is ad-hoc urban sprawling.

Translation of root causes by dynamic pressure into unsafe conditions

The low-income people may occupy land with low demand that may be disaster-prone. They may not have the income to adhere to safe practices and building codes. They may not have proper sanitary conditions, water supply and other utilities. The local governments may come under pressure to provide them but would be unable to do so. But these are dynamic communities that grow and change adding more and more pressure on limited resources.
may show low literacy rates, lack of awareness of disaster potential or preparedness, lack of proper health care which decrease strength to withstand disaster impact, malnutrition, lack of training for livelihoods, disaster prone housing etc.

These are unsafe conditions which increase the vulnerability of these communities. They would have no capacity to face a hazard event. When a hazard event happens these communities would bear the brunt of impact and their losses would be greater. Their capacity to recover is minimal. The biggest impact of disasters is therefore on these more vulnerable communities due to the unsafe conditions they live in.

PAR Model proceeds from the premise that a disaster happens when and only when, a hazard impacts on a vulnerable community or people. A hazard is the trigger event, which sets off the disaster. It could be an earthquake, volcanic eruption, landslide, flood or civil conflict. The unsafe conditions are the vulnerable context where people and property are exposed to risk of disaster.

**Exercise:**

Dear participants, please take an example of a serious problematic (unsafe) condition in your community and analyze it from “pressure and release models” point of approach. For example, unsafe conditions may be: the increasing incidence of traffic accidents; the unsafe conditions of the schools in your area; the dangerous roads in the outskirt of the city; the conflicts between cattle herders at the borders.

**b. Pelling’s human vulnerability framework**

Pelling (2003), whose work focuses on urban environmental risk, differentiates vulnerability into three components: **exposure, resistance and resilience**. According to him, **exposure** is largely a product of physical location and the character of the surrounding man-made and natural environments. The exposure component can be reduced through hazard mitigation
methods employed by individuals or single households or collectively through public–private social investment policy schemes, such as by establishing strict seismic design codes for public buildings.

**Resistance** reflects economic, psychological and physical health and their systems of maintenance, and represents the capacity of an individual or group of people to withstand the impact of a hazard. It is highly correlated with the asset potential of individuals or households. If resistance is low, even a small hazard stress can result in the failure of a system.

**Resilience** is viewed as the ability of an actor to cope with, or adapt to, hazard stress. It is a product of the degree of preparation undertaken in light of a potential hazard, and of spontaneous or premeditated adjustments made in response to a hazard, including relief and rescue. The most important policy options available to boost resilience are those that shape formal or informal insurance mechanisms.

Pelling further clarifies that all the components of vulnerability are shaped by access to rights, resources and assets, therefore attributing household vulnerability as an outcome of cycles of resource accumulation and expenditure. This conceptualization states that household access to sufficient resources to maintain its members and offer sufficient buffering to prevent or absorb disaster losses is determined by a household’s access to assets and the decisions that are made about their use.

Assets which affect coping ability tend to be less common when vulnerability is already high, resulting in the ‘ratchet’ effects of vulnerability. In this context, economic vulnerability increases exposure to losses from disaster shocks, and with each new hazardous event those impacted become more vulnerable to future events. Pelling identified savings, material possessions and tools, labour and the dwelling as important productive assets in urban areas.
Both the PAR model and the Human Vulnerability Framework illustrate the diversity of interpretations associated with disaster vulnerability. In disaster risk literature, there are different interpretations of vulnerability in the context of external shocks and hazards in which some definitions view vulnerability as an **outcome** and others as a **process**. However, there is general consensus among the literatures that vulnerability to disaster is ‘determined not simply by a lack of wealth but rather a complex range of physical, economic, political and social factors or the predisposition of a community to damage by a destabilizing phenomenon involving independent natural hazard and anthropogenic pressures’.
ii. Vulnerability in the context of famine & food insecurity

Vulnerability to food insecurity is explained, through so-called entitlement theory, as a set of linked economic and institutional factors. Entitlements are the actual or potential resources available to individuals based on their own production, assets or reciprocal arrangements. Food insecurity is therefore a consequence of human activity, which can be prevented by modified behaviour and by political interventions. Vulnerability is the result of processes in which humans actively engage and which they can almost always prevent.

**Box 3.1: The theory of entitlements:**

As an explanation for famine causes was developed in the early 1980s and displaced prior notions that shortfalls in food production through drought, flood, or pest, were the principal cause of famine. It focused instead on the effective demand for food, and the social and economic means of obtaining it.

Entitlements are sources of welfare or income that are realized or are latent. They are ‘the set of alternative commodity bundles that a person can command in a society using the totality of rights and opportunities that he or she faces’. Essentially, vulnerability of livelihoods to shocks occurs when people have insufficient real income and wealth, and when there is a breakdown in other previously held endowments. Famines and other crises occur when entitlements fail.

While the entitlements approach to analysing vulnerability to famine often underplayed ecological or physical risk, it succeeded in highlighting social differentiation in cause and outcome of vulnerability. Vulnerability is therefore seen to be key concept, referring to factors that place people at risk of becoming food insecure or reducing their ability to cope.
N:B:

The advantage of the entitlements approach to famine is that it can be used to explain situations where populations have been vulnerable to famine even where there are no absolute shortages of food or obvious environmental drivers at work.

Food insecurity is an outcome of vulnerability, and that both are indistinguishable but two distinct points on a timeline. The difference between food insecure and vulnerable people is one of a degree. Vulnerable people have a high probability of becoming food insecure at any time. Food insecure people are vulnerable people who can no longer meet their minimum food needs. Food security analysts therefore define vulnerability in relation to a general outcome: famine. Therefore, households are vulnerable to hunger, food insecurity, or famine rather than being vulnerable to droughts, floods or market crashes.

iii. Vulnerability in the context of poverty & livelihood insecurity

A broad understanding of the relationship between poverty and vulnerability stretches back to the mid 1990s. Poverty itself is often thought of as some level of well being (or livelihood outcomes, in the language of the livelihoods framework) below which one is impoverished, and above which, one is not. It is thus about current status, and often heavily associated with material status, though social and political elements have slowly been incorporated in the general understanding of poverty.

Vulnerability, on the other hand, was classically defined as exposure to risk and stress, and the lack of ability to cope with the consequences of risk, which may leave one impoverished (or worse), but the basic concept is more about risk, and the ability to cope with it, than it is about current material status. However, there are many linkages between material and social status and risk. Understanding vulnerability in the context of poverty complements the hazards-based approaches through conceptualization and measurement of the links between risk and well-being at the individual level.
A sustainable livelihood refers to the well-being of a person or household and comprises the capabilities, assets and activities that lead to well-being. Vulnerability in this context therefore refers to the susceptibility to circumstances of not being able to sustain a livelihood: the concepts are most often applied in the context of development assistance and poverty alleviation. In this conceptualization of vulnerability, the physical and ecological dynamics of risk received little attention. The principal focus is on consumption of poor households as a manifestation of vulnerability.

iv. Vulnerability in the context of climate change

The science of climate change relies on insights from multiple disciplines and is founded on multiple epistemologies. Climate change is, in addition, unusually focused on consensus because of the nature of evidence and interaction of science with a highly contested legal instrument, the UN Framework Convention on Climate Change.

The full range of concepts and approaches highlighted above are used within vulnerability assessments of climate change. Some scholars argue that this diversity of approaches confuses policy-makers due to the difficulty to explicitly portray vulnerability as an outcome or vulnerability as a context in which climate risks are dealt with and adapted to.

The IPCC defines vulnerability within the latest assessment report as ‘the degree, to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity’. Vulnerability to climate change in this context is therefore defined as a characteristic of a system and as a function of exposure, sensitivity and adaptive capacity.

The IPCC reports make assertions as to the determinants of both vulnerability and adaptive capacity. For example, the 1996 report states that the determinants of adaptive capacity are directly correlated with measures of economic development (GDP per capital). Hence,
developing countries are asserted to be more vulnerable to climate change because among other things, of their ‘lack of institutional capacity’ (usually interpreted as a lack of capacity of government). This is an apparent paradox in the IPCC conclusions on vulnerability of regions. While developing countries are portrayed as ‘most vulnerable’ there is, at the same time, much evidence, from the Arctic to the Sahel, suggesting that communities and countries themselves have significant capacity to adapt latent in local knowledge and experience of coping with variability.

The paradox derives from two faces of vulnerability—a state of ‘powerlessness and endangerment’ and the recognition of the ability of social-ecological systems to adapt to changing circumstances. Some scholars explain this paradox by highlighting the separate epistemological positions on ‘vulnerability as outcome’ versus ‘contextual vulnerability’.

The unequal distribution of vulnerability to climate change is therefore exacerbated by pre-existing inequalities. Vulnerability research also allows for systematic investigation of the potential for pro-active adaptation and for system-wide changes well-being linked to ecosystems.

### 3.3 DIVERGENCE AND CONVERGENCE OF VULNERABILITY APPROACHES

This review of approaches demonstrates diverging conceptions of vulnerability due to the different epistemological positions of research traditions and because of differing objectives of research in these areas. However, the points of convergence are more numerous and more fundamental than the points of divergence in conceptualizing vulnerability. There are common terms across theoretical approaches: vulnerability is most often conceptualized as being constituted by components that include **exposure** and **sensitivity** to perturbations or external stresses, and the **capacity to adapt**. **Exposure** is the nature and degree to which a system experiences environmental or socio-political stress. The characteristics of these stresses include their magnitude, frequency, duration and areal extent of the hazard. **Sensitivity** is the degree to
which a system is modified or affected by perturbations. **Adaptive capacity** is the ability of a system to evolve in order to accommodate environmental hazards or policy change and to expand the range of variability with which it can cope.
Dear Participants! Given the above explanation about the objective and nature of Vulnerability approaches in different contexts, please complete the table with the aim of identifying weaknesses and strengths of the approach in terms of robustness in explaining the different dimensions of vulnerability; in terms of dynamicity in capturing the changing nature of processes related to vulnerability; in terms of applicability in informing decision makers towards appropriate vulnerability reduction programs.

<table>
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<td>Vulnerability in the context of disaster risk</td>
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<td>Objective</td>
<td>Structural analysis of underlying causes of vulnerability to natural hazards. Further developed human ecology model to link discrete risks with political economy of resources and normative disaster management Intervention.</td>
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<td>Robustness</td>
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Box 3.2: Major factors driving vulnerability:

Urbanization (Especially low income families in informal settlements and urban slums are more likely to encounter greater risks from natural hazards – because living in closely built structures that disrupt natural land drainage patterns and water courses – e.g. Venezuela 1999 (30,000 deaths in urban landslides). Almost all population increase concentrated in urban areas, especially in Low Development Countries (LDCs).

Increasing growth in small cities < 1 million

War/armed conflict (at all scales)

Global economic pressures (Reduced prices for agricultural and mineral exports vs increased import costs for energy; structural adjustment programmes to reduce debt).

Unfavorable agrarian trends (i.e. reduced agricultural production)

Natural resource depletion (deforestation, wetland destruction, soil erosion)

3.4 DIMENSIONS OF VULNERABILITY

• Generally with respect to vulnerability, there are always two key components

  – An external dimension related to exposure to shocks, stresses and risks

  – An internal dimension of ‘defenselessness' – or lack of a means to cope without damaging loss.

In view of the above conceptualization, there are different dimensions of vulnerability.

1. Physical vulnerability- refers to susceptibilities of the built environment and is mainly described as exposure. Physical aspects of vulnerability include the effect of location and susceptibilities of the built environment. It may be exposure to hazards, living in harmful ways
or being in the wrong place at the wrong time. Physical vulnerability refers to the susceptibility of individuals, households and communities to the physical environment in which they find themselves. It relates to aspects such as access to suitable land, land use planning, housing design, building standards, materials used for building houses, accessibility to emergency services and other related aspects. Physical vulnerability also relates to remotely located settlements, as well as to lack of access to services, infrastructure and information.

2. Social vulnerability- this characterizes levels of literacy, health infrastructure, peace and security, access to basic human rights, systems of good governance, social equity, traditional values, customs and ideological beliefs etc. Social factors of vulnerability are linked to the level of wellbeing of individuals, communities and societies. It includes aspects related to level of literacy and education, the existence of peace and security, access to basic human rights, systems of governance, social equity, positive traditional values, knowledge structures, customs and ideological beliefs and overall organizational systems. These all contribute to social wellbeing with physical, mental and psychological health being critical aspects.

Lack of awareness and lack of access to information can also result in increased levels of vulnerability. Disasters can happen because vulnerable people simply do not know how to heed early warnings, get out of harm’s away or take proactive measures. In addition, individuals and communities may not know where to turn to for assistance when disasters strike.

Some groups are more vulnerable than others: those less privileged in class and cast structures, ethnic minorities, the very young, very old and other disadvantaged and marginalized segments of the population. Women’s role in households (the responsibility for domestic life, essential shelter and basic needs) make them more likely to be even more burdened and especially vulnerable in times of disaster.

Social factors of vulnerability are characterized by increased criminal activity; higher incidence of HIV/AIDS; high rates of children dropping out of school; declining age of prison population; declining public health; deteriorating public infrastructure; and migration of skilled professionals.
These are all symptoms of negative social processes which result in increased social vulnerability.

3. Economic vulnerability - Levels of vulnerability are highly dependent upon the economic status of individuals, communities and nations. The poor are in general far more vulnerable than economically better off sectors of society. Poverty has the single most important influence. This relates both to proportionally higher losses when a disaster strikes as well as to lower capacity to recover.

Economic factors of vulnerability includes levels of individual, community and national economic reserves, levels of debt and degree of access to credit and loans, as well as insurance. An economy lacking in diversity is generally more vulnerable. Similarly, inadequate access to critical and basic socio-economic infrastructure, including communication networks, utilities and supplies and transportation facilities, increase people’s exposure to risk. Lack of access to basic services, such as water, forces people to use unsafe sources for cooking and drinking and place them at risk from disease and epidemics. People without access to electricity or alternative fuel sources are forced to cut down trees for firewood, which in turn leads to environmental degradation and can increase the danger of flooding.

Economic status of the population relates not only to the degree of losses in terms of lives, property and infrastructure but also the capacity to cope with and recover from adverse effects. Virtually all studies have shown that the wealthiest sector of the population either survives the impact of a hazard without suffering any adverse effects or are able to recover quickly. Poverty and lack of access to land forces people to build temporary, unsafe dwellings in crowded, dangerous locations. Poverty explains why drought claims poor subsistence farmers as victims but rarely the wealthy and why, more often than not, famine is the result of lack of purchasing power rather than absence of food. Vulnerability is not just poverty, but the poor tend to be the most vulnerable.
4. Environmental/ecological vulnerability:-refers to the extent of natural resource degradation (i.e. ecosystem or environmental fragility) e.g. contaminated air, water and inadequate sanitation threatened health, diminished biodiversity, soil degradation, and water scarcity threatened food security. Many disasters are either caused or exacerbated by environmental degradation. Deforestation leads to rapid rain runoff, which contributes to flooding. The creation of drought conditions and the relative severity and length of time the drought lasts is mainly a natural phenomenon. But drought conditions may be exacerbated by poor cropping patterns, overgrazing, the stripping of topsoil, poor conservation techniques, depletion of both surface and sub-surface water supplies and unchecked urbanization.

The key aspects of environmental factors of vulnerability can be summarized as: the extent of natural resource depletion; the state of resource degradation; loss of resilience of the ecological system; loss of biodiversity; exposure to toxic and hazardous pollutants.

3.5 VULNERABILITY AND CAPACITY ASSESSMENT

Vulnerability and capacity assessments are an indispensable complement to hazard assessment exercises. Despite the considerable efforts and achievements reflected in improved quality and coverage of scientific data on different hazards, the mapping and assessing of social, economic and environmental vulnerabilities of the population are not equally developed. Some aspects of vulnerability/capacity, especially those related to the social nature of these concepts, pose a different range of challenges to the process of risk assessment.

The most important dimension of vulnerability assessment is the presentation of the results and the understanding of the added value by policy makers. As discussed in chapter two, despite difficulties in harmonizing methods and approaches used in multi-hazard assessment and mapping, the use of GIS techniques have facilitated and improved the process of hazard mapping and critical facility mapping (as part of the physical vulnerability analysis). However, given the diverging conceptions of vulnerability due to different discipline contexts, as well as its different dimensions, vulnerability assessment and mapping remains difficult.
Particularly, the inclusion of social, economic and environmental variables into GIS’s conceptual models remains as a major methodological challenge. The need to assign a quantifiable value to the variables analyzed into the spatial models used by GIS is not always possible for some social/economic dimensions of vulnerability – for instance, how to quantify the ideological and cultural aspects of vulnerability. Moreover, the diverse scales – individual, family, community, regional – at which different dimensions of socio-economic vulnerability operate, makes the spatial representation through these techniques, very difficult.

Generally speaking, the physical aspects of vulnerability assessment are tailored from exposure to hazards criteria, providing answers to the questions of what is vulnerable and where is it vulnerable. The attempts to assess socioeconomic aspects of vulnerability intend to answer the questions ‘who’ is vulnerable, and ‘how’ have they become vulnerable. Several research initiatives are aiming to bring solutions to the current methodological constraints, especially the quantification of social aspects of vulnerability. Still, the socio-economic vulnerability assessments rely on more conventional ways, which indeed provide other opportunities and advantages, such as the active involvement of the community at risk in exercises as community based mapping and assessments.

The development of models and conceptual frameworks provided a basis for vulnerability analysis in relation to specific hazards. Pressure and Release, and Access models, presented in the mid 1990s (see section 3.3), provided a good basis for the analysis and further identification of specific vulnerable conditions. These models linked dynamic processes at different scales, and different access to resources profiles, with vulnerability conditions.

**Vulnerability/capacity assessment approaches/methods**

The relationship between vulnerability and capacity has been increasingly expressed in risk assessment methodologies in terms of Vulnerability and Capacities Assessment (VCA). Work has been done to develop, test and validate tools, methodologies and other instruments for factoring in issues related to social inequity, including gender analysis, into risk management at the local level. These aspects include participatory diagnosis, training methods, and a number
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of analytical frameworks such as the (CVA) which examines people’s strengths and abilities, as well as their susceptibilities, and the Socio-Economic and Gender Analysis (SEAGA), which look at disadvantaged social groups, incorporating them into the development process as effective change agents, rather than only as beneficiaries.

As the concept of vulnerability can be understood in different contexts in relation to food security, disaster risk, poverty, and climate change, various approaches to the assessment of vulnerability and capacity have been developed and adopted by different institutions. For the purpose of this module, a livelihood approach to be employed to assessment of vulnerability/capacity to the impacts of hazards will be discussed below.

The following is not an exhaustive checklist, but it gives an indication of some of the vulnerabilities that have been identified under each capital heading at a number of DRR workshops held with Concern programmes:

**Human Capital:** The health status including mental, psychological, nutritional and HIV/AIDS. Lack of skills and knowledge including lack of understanding of the hazard, their causes and how to reduce impacts. Illiteracy means people cannot access written information or correspond with authorities. Agricultural practices where these have resulted in environmental degradation or limited types of food produced by mono-cropping.

**Social Capital:** The disintegration of family ties, social institutions and kinship support after conflict. Lack of peace and security, access to good governance, social equity, and degree of respect for human rights, loss of traditional values, knowledge, customs and social organisation. People belonging to different ethnic, tribal, religious and political groups may be excluded from collective community actions. Female headed households, unaccompanied children and women, the very young and the elderly.

**Political Capital:** The political power or access to it of the communities themselves and the wider political environment are identified as being equally important. The lack of, or non-enforcement of, policies - for example, absence of natural resource management may increase
vulnerability to flooding and drought. Poor governance in the form of corruption, nepotism, favouritism, bias and lack of effective institutions were regularly discussed under this capital as was the improper allocation of money for development work.

**Financial Capital:** Lack of wider financial infrastructure and organisation. The absence of banks and credit and savings schemes, lack of markets, jobs and income generating opportunities.

**Physical Capital:** Physical location and the strength and suitability of built infrastructure including houses. Population density, remoteness of a community, its location in relation to topographical features, design, use and availability of building materials. Lack or destruction of public buildings such as community halls and training facilities, roads, airstrips, health posts, hospitals and schools. Lack or destruction of water supply infrastructure includes provision of potable and irrigation water, storage and flood drainage facilities including soil and water conservation infrastructure such as gabion cages and earth bunds.

**Natural Capital:** These assets are particularly prone to seasonal changes and include the availability of water, game animals and annual plants. Land quality depends on its topography, soil characteristics and fertility, as well as rainfall patterns. Loss of access to cultivation land through, for example, conflict or perhaps flooding. Access denied based on gender, ethnic identity or religious grounds. The right of exploitation of these assets is often not in the hands of local communities - e.g. minerals and timber.

### CASE STUDY:

A joint research was conducted by collaboration between Bahir Dar University (Department of Disaster Risk Management and Sustainable Development) and University of Jaume I (Spain) by the sponsorship of the Spanish Development Cooperation in 2010. The major objective of the study was to explore the natural as well as manmade hazards and associated disaster risks prevalent in Amhara Region and to identify communities’ vulnerability and capacity to withstand the impacts of disaster risks from a local management approach perspective. In order to cover a wide range of hazards, the study areas Habru woreda from the North Wollo and
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Fogera woreda from South Gondar were selected. The major hazards affecting communities in Habru woreda were drought and conflict. In order to measure the level of vulnerability/capacity to the identified major hazards, communities were asked to identify the major impacts of identified hazards. Crop failure and pasture failure were identified as the major impacts of drought, whereas, loss of life and property (livestock, land) were identified as the major impacts associated to conflict.

After identifying the major impacts of hazards, the first step in the process of determining level of vulnerability/capacity to the impacts of the identified hazards was developing measurable and appropriate indicators in relation to the impacts of a specific hazard. The following table, for example, shows key indicators to measure the level of vulnerability/capacity to the impacts of conflict and drought in Habru.

<table>
<thead>
<tr>
<th>Table 1. Indicators of vulnerability/capacity to the impacts of Drought in Habru Woreda</th>
<th>Examples of vulnerabilities related to Livelihood capitals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Human capital</strong></td>
<td>Communities’ ability to understand drought early warning information and availability of coping and adaptive strategies to drought</td>
</tr>
<tr>
<td><strong>Physical capital</strong></td>
<td>Availability and accessibility of modern farm implements and irrigation technologies</td>
</tr>
<tr>
<td><strong>Social capital</strong></td>
<td>Availability of remittances and the level of helping each other during hard times (crop failure)</td>
</tr>
<tr>
<td><strong>Financial capital</strong></td>
<td>Availability of off/non-farm employment opportunities and accessibility of credit services to meet food and non-essential household needs during hard times</td>
</tr>
<tr>
<td><strong>Natural capital</strong></td>
<td>Availability of perennial rivers, and level of vegetation cover and soil fertility</td>
</tr>
<tr>
<td><strong>Political capital</strong></td>
<td>The role of local authorities in facilitating coordinating activities related to development and disaster risk management</td>
</tr>
</tbody>
</table>

The second step was classifying the levels of vulnerability/capacity into different categories. For example, the following represents the ranking order of vulnerability/capacity:
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- Capacity evident, low level of vulnerability (4)
- Some capacity, medium level of vulnerability (3)
- Little capacity, high level of vulnerability (2)
- No capacity, extreme level of vulnerability (1)

Based on this ranking order, communities in the study area were asked to rank the level of vulnerability/capacity to the identified impacts of hazards based on the six livelihood assets. For example the following table describes the level of vulnerability/capacity to the impacts of drought in relation to physical capital.

<table>
<thead>
<tr>
<th>Types of asset</th>
<th>Ranking order</th>
<th>weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical capital</td>
<td>There is very good access to modern farm implements and water harvesting technologies to practice irrigation in the locality.</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>There is good access to modern farm implements and water harvesting technologies to practice irrigation in the locality.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>There is limited access to modern farm implements and water harvesting technologies to practice irrigation in the locality.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>There is no any means to practice irrigation in the locality.</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2. Levels of communities’ capacity/vulnerability to the impacts of drought and conflict in Habru woreda as ranked by focus group participants

<table>
<thead>
<tr>
<th>Asset</th>
<th>Score</th>
<th>Drought</th>
<th>Remark</th>
<th>conflict</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human capital</td>
<td>2.5</td>
<td>Between little capacity, high level of vulnerability and Some capacity, medium level of vulnerability</td>
<td>2</td>
<td>Little capacity, high level of vulnerability</td>
<td></td>
</tr>
<tr>
<td>Physical</td>
<td>2</td>
<td>Little capacity, high level of vulnerability</td>
<td>1.5</td>
<td>Between no capacity, extreme level</td>
<td></td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>capital</th>
<th>Level of Vulnerability and Capacity</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social capital</td>
<td>3 Some capacity, medium level of vulnerability</td>
<td>2 Little capacity, high level of vulnerability</td>
</tr>
<tr>
<td>Financial capital</td>
<td>2.5 Between little capacity, high level of vulnerability and Some capacity, medium level of vulnerability</td>
<td>3 Some capacity, medium level of vulnerability</td>
</tr>
<tr>
<td>Natural capita</td>
<td>2 Little capacity, high level of vulnerability</td>
<td>2.5 Between little capacity, high level of vulnerability and Some capacity, medium level of vulnerability</td>
</tr>
<tr>
<td>Political capital</td>
<td>3 Some capacity, medium level of vulnerability</td>
<td>3 Some capacity, medium level of vulnerability</td>
</tr>
<tr>
<td>Total</td>
<td>15/6≈2.5 Between little capacity, high level of vulnerability and Some capacity, medium level of vulnerability</td>
<td>14/6≈2.3 Close to Little capacity, high level of vulnerability</td>
</tr>
</tbody>
</table>

**N:B:**

Several vulnerability/capacity ranking exercise should be made in relation to different impacts of a single hazard because level of vulnerability varies depending on the type of impact that a particular hazard with the same level magnitude could pose. For example a certain magnitude of drought hazard might result in crop failure, pasture failure and malnutrition. However the level of vulnerability/capacity to the impacts of crop failure, pasture failure, and malnutrition associated to drought might be different. This is very important in determining the level of risk of, for example, crop failure, pasture failure, as well as the level of risk of malnutrition associated to drought hazard with the same magnitude. Therefore, it is the level of vulnerability/capacity to the identified impacts of a certain hazard that finally determines the level of risk associated to it and used as the basis for identifying priority risks in order to plan for appropriate risk reduction strategies. Priority risk is a function of very high magnitude hazard and extreme level of vulnerability and limited capacity to the impacts of the specified hazard.

Based on scores given in Table 2, the following figure (4) depicts robustness of the community’s assets in responding to the impacts of drought and conflict in Habru woreda. The shape of the pentagon can be used to show schematically the variation in people’s access o assets in responding to the impacts of
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Drought and frost. The idea is that the centre point of the hexagon, where the lines meet, represents zero access to assets while the outer perimeter represents maximum access to assets where there is strong adaptive capacity to respond to the identified hazards.

Figure 3: Livelihood asset hexagon: Level of available communities’ capacity/vulnerability to the impacts of drought and conflict in Habru woreda (source: BDU-DRMSD, 2010).

Reference:


Concern, Emergency Unit (2005). Approaches to Disaster Risk Reduction.

Adger, N. (2005). Global Environmental Change. Vulnerability. Tyndall Centre for Climate Change Research, School of Environmental Sciences, University of East Anglia, Norwich
CHAPTER 4: UNDERSTANDING RISK

General description:
This chapter tries to comprehend issues discussed in the previous chapters and raises awareness about the nature of risk, with emphasis on the linkages between hazards and vulnerability. Such awareness is useful in the process of disaster risk management.

Learning Objectives:
At the end of this chapter, the participants should be able to:

- Understand the nature of risk, with emphasis on the linkages between hazards and vulnerability.
- Understand the process of risk assessment
- Explain the concept of risk perception and its implication for disaster risk reduction.

Key Concepts

- The concept of risk has evolved from the conventional view of risk as ‘probability of (loss) X (loss)’ to ontological or sociological concept of risk that incorporates socio-cultural characteristics of disaster risk in relation to the interaction between hazards and vulnerabilities.
- In the context of disaster management, risk can be defined as ‘the probability of harmful consequences, or expected loss (of lives, people injured, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human induced hazards and vulnerable/capable conditions’.
- Disaster risk is part of everyday life. Awareness of risk is therefore a necessary condition to engage in disaster risk reduction.
- Levels of risk awareness depend largely upon the quantity and quality of available information and on the difference in people’s perceptions of risk.
- New trends in hazards and vulnerability challenge the procedures and conventional methodologies, and call for a truly integrated, comprehensive and very dynamic risk assessment.
4.1 WHAT IS RISK?

The concept of “risk” has evolved from the conventional view of risk as “an expected value of the probability of a hazardous event occurring times the magnitude of the consequence of the hazard” to an ontological or sociological concept of “risk” that allows us to take into consideration a wide range of socio-cultural characteristics of disaster risks. From among such attempts that define an interdisciplinary concept of risk, we take one of the simplest ones: risk is “a potential for the realization of unwanted, adverse consequences to human life, health, property, or the environment.”

This simple concept originated from extended discussions to define an interdisciplinary concept of risk at the Society for Risk Analysis (SRA).

Several models of disaster risk analysis framework have been developed to deal with the uncertain and complex nature of natural hazards, and these explore the relationships between hazards and damages in terms of either risk or vulnerability. For the purpose of this module, let’s discuss three ways of risk conceptualizations. First, understanding risk as a risk triplet as proposed by Kaplan and Garrick (1981)- Risk = \( \{S_i, P_i, D_i\} \), where:

- \( S_i \): a set of scenarios concerning the nature of possible events
- \( P_i \): a set of likelihoods concerning event frequency, probability, or ambiguity
- \( D_i \): a set of consequences concerning potential damage to humans, animals, plants, and the environment.

\[ \text{Risk} = \{S_i, P_i, D_i\} \] \hspace{1cm} \text{equation 1}

The risk triplet consists of scenario ‘S’, likelihood ‘P’, and possible consequence ‘D’ in relation to three basic questions of risk analysis:

1) What is the nature of disaster events that can occur?
2) How likely is a particular event occurring?
3) What are the consequences?

Second, understanding risk in relation to hazard and vulnerability based on the disaster risk model of Alexander (1993) - Risk = Hazard × Vulnerability. Wisner et al. (2004) advocated the pressure and release model (PAR model) as a means to understand risk in more realistic terms of vulnerability in the field of disaster sciences. In the PAR model, vulnerability is defined as “the degree to which someone’s life, properties and other assets are put at risk by events in nature and in society”, which can be measured in terms of potential damage.

\[ \text{Risk} = \text{Hazard} \times \text{Vulnerability} \]

Third, understanding risk in reference to the conventional expression of risk provided by Smith (2001) - Risk = Hazard(Probability) × Loss(Damage)/Preparedness(Resilience). In this regard, risk (expressed in consequence per time) is an expected value of the probability (expressed in event per time) of a hazardous event occurring times the magnitude (consequence per event) of the consequence of the hazard.

\[ \text{Risk} = \text{Hazard (Probability)} \times \text{Loss (Damage)}/\text{Preparedness (Resilience)} \]

Wisner’s definition of “risk” as “hazard times vulnerability” can be interpreted as a unit measure of the possible damages ‘D’ under an exposure probability ‘P’ to the hazardous event in our risk triplet expression R{Si,Pi,Di} (equation 1), where risk scenario ‘S’ is implicitly taken into consideration as a degree of vulnerability in (equation 2), or the preparedness in Smith’s definition of risk in (equation 3).

Despite various conceptualizations of risk, the following are common elements in expressing the term ‘risk’:

- It is an expectation of loss
- It refers to the future
4.2 THE NATURE OF RISK: IN THE CONTEXT OF DISASTER MANAGEMENT

Disaster risk is part of everyday life. Awareness about risk is therefore a necessary condition to engage in disaster risk reduction. The focus on risk management, rather than on the disaster event, reflects a proactive attitude for dealing with potential threats to social and materials assets, before they are lost. The analysis and lessons learned from prior experiences of disasters help to define profiles of risk attached to people, activities and places that share attributes, in the face of particular potential sources of damage. Understanding risk relates to the ability to define what could happen in the future, given a range of possible alternatives to choose from. Assessing risks, based on vulnerability and hazard analysis, is a required step for the adoption of adequate and successful disaster reduction policies and measures.

Levels of risk awareness depend largely upon the quantity and quality of available information and on the difference in people’s perceptions of risk. People are more vulnerable when they are not aware of the hazards that pose a threat to their lives and assets. Risk awareness varies among people, communities, agencies and governments, according to their particular perceptions. These can be influenced by the knowledge of hazards and vulnerabilities, as well as by the availability of accurate and timely information about them.

In the context of disaster management, risk can be defined as ‘the probability of harmful consequences, or expected loss (of lives, people injured, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human induced hazards and vulnerable/capable conditions’ (ISDR, 2002).

Given the above ISDR definition of risk, two elements are essential in the formulation of risk (hereafter referred as disaster risk):

a) The probability of occurrence for a given threat – hazard; and

b) The degree of susceptibility of the element exposed to that source – vulnerability.
The negative impact, or the disaster (the realized risk), will depend on the characteristics, probability and intensity of the hazard, as well as the susceptibility of the exposed elements based on physical, social, economic and environmental conditions. The recognition of vulnerability as a key element in the risk equation has also been accompanied by a growing interest in linking the positive capacities of people to cope, withstand and recover from the impact of hazards. It conveys a sense of the potential for managerial and operational capabilities to reduce the extent of hazards and the degree of vulnerability. This awareness is reflected by the incorporation of capacity in the risk equation:

\[ \text{Risk} = \frac{\text{Hazard (H)} \times \text{Vulnerability (V)}}{\text{Capacity (C)}} \]

\[ \text{Risk} = \text{function of (H and V/C)} \]

Social dimensions are intimately linked to the decision-making process to deal with disaster risk, as they embrace a range of risk perceptions and their underlying causes. A closer look at the nature of hazards and the notions of vulnerability and capacities in the context of disaster risk, allows for a better and more comprehensive understanding of the challenges posed by disaster risk reduction.

4.3 RISK ASSESSMENT

Risk assessment is a process 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. Risk assessments include detailed quantitative and qualitative information and understanding of risk, its physical, social, economic, and environmental factors and consequences. It is a necessary first step for any other disaster reduction measure.
Risk assessment encompasses the systematic use of available information to determine the likelihood of certain events occurring and the magnitude of their possible consequences. As a process, it is generally agreed upon that it includes the following activities:

- Identifying the nature, location, intensity and probability of a threat.
- Determining the existence and degree of vulnerabilities and exposure to the threat.
- Identifying the capacities and resources available.
- Determining acceptable levels of risk.

The analytical phases involved in risk assessment include some of the basic tasks for risk management. The following diagram shows the basic stages undertaken in a risk assessment process.
The identification of hazards usually constitutes the departing point for the risk assessment process. Both hazard and vulnerability/capacity assessments utilize formal procedures that include collection of primary data, monitoring, data processing, mapping, and social surveys techniques, among others. In the case of hazard assessment, where usually high technological developments for monitoring and storing data of geological and atmospheric processes are involved, the assessment activities are mostly restricted to a scientific community. On the other hand, vulnerability and capacity assessments make use of more conventional methodologies and techniques, by which the community at risk may also play an active role, such as in community-based mapping.

![Stages of risk assessment](image-url)
Beyond these particularities, hazard and vulnerability/capacity assessment follow a set of more or less formal procedures that are generally captured under the concept of risk analysis. In this regard, risk analysis constitutes a core stage of the whole risk assessment process by means of providing relatively objective and technical information from which levels of risk can be estimated. The information produced by technical risk analysis allows for the establishment of impartial government policy, resources needed for disaster preparedness, and insurance schemes. But from the estimated levels of risk to the determination of acceptable levels of risk, a different range of value judgments are usually taken into account. Socio-economic cost/benefit analyses usually lead to the establishment of priorities that in turn help to draw levels of acceptable risk. These levels will depend largely on government, community priorities, interests and capacities. It is at this stage, particularly, when the more subjective trade-offs of quantitative and qualitative approaches to risk assessment need to be sorted out.

**Risk assessment vs. Risk perception**

The distinction between risk assessment and risk perception has important implications for disaster risk reduction. In some cases, as in vulnerability/capacity assessment exercises, risk perception may be formally included in the assessment process, by incorporating people’s own ideas and perceptions on the risks they are exposed to. Nevertheless, the wide and increasing use of computer assisted techniques and methodologies – such as those involved in Geographic Information Systems (GIS) – may widen the breach between the information produced by technical risk assessments and the understanding of risk by people. The table below shows the differences between objective risk and perceived risk.
Table 4.1. The difference between objective risk and perceived risk

<table>
<thead>
<tr>
<th>Technical attitude to risk (objective risk)</th>
<th>Cultural attitude to risk (perceived risk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trust in scientific methods, explanations and evidence</td>
<td>Trust in political culture and democratic process</td>
</tr>
<tr>
<td>Appeal to authority and expertise</td>
<td>Appeal to folk wisdom, peer group and traditions</td>
</tr>
<tr>
<td>Boundaries of analysis are narrow and reductionist</td>
<td>Boundaries of analysis are broad; includes use of analogy and historical precedent</td>
</tr>
<tr>
<td>Risks are depersonalized</td>
<td>Risks are personalized</td>
</tr>
<tr>
<td>Emphasis on statistical variation and probability</td>
<td>Emphasis on the impacts of risk on the family and community</td>
</tr>
<tr>
<td>Appeal to consistency and universality</td>
<td>Focus on the particularity; less concern about consistency of approach</td>
</tr>
<tr>
<td>Where there is controversy in science, resolution follows status</td>
<td>Popular responses to scientific differences do not follow prestige principle</td>
</tr>
<tr>
<td>Impacts that cannot be specific are irrelevant</td>
<td>Unanticipated or unarticulated risks are relevant</td>
</tr>
</tbody>
</table>

Therefore, acceptable levels of risk may vary according to the relative contribution of views on objective risk versus perceived risk, at the various individual, community and institutional scales.

**BOX 4.2: The Concept of Risk Perception and its Implication for Disaster Risk Reduction.**

It is important to consider people’s perceptions and attitudes in risk assessment because these will strongly influence their actions. The way the risk is perceived determines the way the risk is reduced. This inevitably leads to the question of whose perceptions of risk are right - if there are right and wrong perceptions. Some may suggest that the opinions of experts in a given field
must be correct, but such opinions are still based on individual perceptions. In addition, experts are not always exposed to the risks they are studying, unlike members of the community. The table below depicts the main differences between risk assessment and risk perception based on the different phases of risk analysis.

Table 4.2: the difference between risk assessment and risk perception

<table>
<thead>
<tr>
<th>Phase of analysis</th>
<th>Risk assessment processes</th>
<th>Risk perception processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk identification</td>
<td>Event monitoring</td>
<td>Individual intuition</td>
</tr>
<tr>
<td></td>
<td>Statistical inference</td>
<td>Personal awareness</td>
</tr>
<tr>
<td>Risk estimation</td>
<td>Magnitude/frequency</td>
<td>Personal experience</td>
</tr>
<tr>
<td></td>
<td>Economic costs</td>
<td>Intangible losses</td>
</tr>
<tr>
<td>Risk evaluation</td>
<td>Cost/benefit analysis</td>
<td>Personality factors</td>
</tr>
<tr>
<td></td>
<td>Community policy</td>
<td>Individual action</td>
</tr>
</tbody>
</table>

Adapted from: K. Smith, 1997

4.4 CHARACTERISTICS OF A RISK ASSESSMENT

Risk assessment involves multi-hazard, multi-sectoral, multi-level, multi-phase, and multi-stakeholder approaches in the process of determining how the risk is created, perceived and reduced.

1. Multi-hazard: identifies the range of hazards and the impact of these hazards on current and planned investments, on different groups of people, and their ability to resist and cope with the impact of hazards.

2. Multi-sectoral: considers current and planned land-use, the building type, communication networks, people’s livelihood, health and education systems, and people’s awareness and commitment to protecting themselves.
3. **Multi-level**: looks at the national, provincial and local policies, plans and activities to see how they have contributed to increased or reduced risk, their strengths and weaknesses in dealing with risks, and what resources are available at different levels to reduce risks.

4. **Multi-stakeholder**: involves relevant individuals and organizations. They may be directly responsible for reducing a specific risk, such as fire. They may be directly affected by risks and / or the measures selected to control them, such as the local residents and business owners. They may have information important to mapping hazards or assessing risks, such as local geologists, engineers, land-use planners, etc.

5. **Multi-phase**: considers disaster management actions for response, recovery, mitigation and preparedness.

### 4.5 COMPONENTS OF RISK ASSESSMENT

A risk assessment consists of three interrelated processes of risk identification, risk analysis, risk evaluation.

1. **IDENTIFICATION OF RISK FACTORS**:

Identification of risk essentially involves:

- **Hazard identification**: identifying the nature, location, intensity and probability of a threat, including estimation of probabilities of occurrence of various hazards of different magnitudes
- **Vulnerability/capacity assessment**: involves determining the existence and degree of vulnerabilities and exposure to the threat, including capacities and resources available.

2. **RISK ANALYSIS/ESTIMATION**:

This involves estimating the risk based on combined information on the magnitude and frequency of hazards with vulnerability to them, taking available capacities into consideration. Risk analysis is therefore made based on the assumption that risk is a function of hazards and vulnerabilities. This requires estimation of the probability of a hazard occurrence at a certain level of severity, within a specific period of time, in a given area as well as quantification of
vulnerability. The methods used to organize and analyze the scientific knowledge and information about potentially hazardous events varies according to the availability of hazard information, inventory data, vulnerability functions and the capacity of those performing the risk analysis to apply qualitative and/or quantitative analysis methods. The level of severity of natural hazards can be quantified in terms of the magnitude of the occurrence as a whole (event parameter) or in terms of the effect the occurrence would have at a particular location (site parameter).

Vulnerability should also be quantified in order to perform risk calculation. Vulnerability can be quantified as the degree of loss to a given element at risk (or set of elements) resulting from a given hazard at a given severity level. The distinction between this definition and that of risk is important to note. Risk combines the expected losses from all levels of hazard severity, also taking into account their occurrence probability. The vulnerability of an element is usually expressed as a percentage loss (or as a value between 0 and 1) for a given hazard severity level. The measure of loss used depends on the element at risk, and accordingly may be measured as a ratio of the numbers of killed or injured to the total population, as a repair cost or as the degree of physical damage defined on an appropriate scale. In a large number of elements, like building stock, it may be defined in terms of the proportion of buildings experiencing particular level of damage. The most important issues that should be considered during risk analysis are changes in disaster frequency, availability of essential data, depth of analysis, and dealing with uncertainty.

3. RISK EVALUATION:

This involves evaluation of the significance and acceptability or tolerance of risk, examining the balance between risks and benefits. The risk evaluation determines the significance of the risk analysis to the ability of project participants to achieve pre-established goals and objectives. Risks are ranked according to their significance, the existence and feasibility of risk reduction solutions, the cost-effectiveness of potential risk reduction solutions, etc. Risks that cannot be reduced because no solution exists or potential solutions are not feasible are called residual
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risks. Residual risks may be addressed through risk financing mechanisms. Risk funding mechanisms do not reduce potential damage and harm, but do reduce potential financial loss and recovery periods after a disaster event. Risks that have been analyzed, but will not be addressed by the implementation of risk reduction actions are considered acceptable risks. Note that acceptable risks are ones that have been assessed and evaluated. Risks that do not affect initial areas of concern may be addressed at a later time if they exceed a level of agreed upon risk acceptance.

In general, the process of risk assessment, which involves several interrelated processes, requires comprehensive and dynamic methodologies identifying, analyzing and evaluating risk. Objective information ascertained from risk analysis has been improved, especially in the identification and monitoring activities involved in hazard assessment. However, some phases in risk assessment remain weak. In particular, incorporating people’s risk perceptions, and the socio-economic and environmental contexts where they live, is essential in the identification of risk scenarios. New trends in hazards and vulnerability also challenge the procedures and conventional methodologies, and call for a truly integrated, comprehensive and very dynamic risk assessment.
Box 4.3: Using risk in decision-making

The estimation of probable future losses is a matter of increasing interest to those concerned with development planning or with the management of facilities or public administration in hazard-prone regions. Future loss estimates are of interest to those responsible for development and physical planning on an urban or regional scale, particularly where planning decisions can have an effect on future losses; for the same reason they are of interest to economic planners on a national or international scale. Loss estimates are also of interest to those who own or manage large numbers of buildings or other vulnerable facilities and to the insurance and reinsurance companies which insure those facilities. Equally, loss estimates are of importance to those responsible for civil protection, relief, and emergency services to enable adequate contingency plans to be prepared; and they concern also those who draft building regulations or codes of practice for construction, whose task is to ensure that adequate protection is provided by those codes at minimum cost.

4.6 RISK MAPPING

Risk maps attempt to show the spatial or geographical distribution of expected losses from one or more natural hazards. The following are some of the common ways of presenting losses:

a. **Scenario Mapping:** The presentation of the impact of a single hazard occurrence. Scenario mapping is often used to estimate the resources likely to be needed to handle an emergency. The number of people killed and injured, and the losses arising in other elements is estimated. From these can be estimated the resources needed for medical attention, to reduce disruption, accommodate homeless, and minimize the recovery period.

b. **Potential Loss Studies:** Mapping the effect of expected hazard occurrence probability across a region or country shows the location of communities likely to suffer heavy losses. The effect of the hazard of each area is calculated for each of the communities within those areas to identify the ‘Communities Most At Risk’. This shows, for example, which towns or villages are likely to suffer highest losses, which should be priorities for loss-reduction.
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programs, and which are likely to need most aid or rescue assistance in the event of a major disaster.

c. **Annualized Risk Mapping:** Calculation of the probable levels of losses occurring from all levels of hazards over a period of time. The probability of each level of hazard occurring within that unit time period is combined with the consequences of that level of hazard to generate the expected loss within that time. Summing up the losses over all levels of hazard gives the total losses expected with time. The map indicates expected losses over both time and space. With sufficient detail in the calculation, the likely effect of mitigation policies on reducing earthquake losses can be estimated, and costed. The relative effects of different policies to reduce losses can be compared or the change in risk over time can be examined.

Reference:


Disaster Management Training Manual, UNDP DRM Programme.

CHAPTER 5: DISASTER MANAGEMENT APPROACHES

General description:
This chapter introduces the conceptual paradigm shift in understanding hazards and disasters as well as the responses to disasters. It also raises awareness about the nature of different disaster management approaches and models. Such awareness is useful in appreciating the role of a holistic and proactive approach to disaster management.

Learning Objectives:
At the end of this chapter, the participants should be able to:

- Describe the conceptual paradigm shift in understanding hazards and disasters as well as the nature of responses to disasters
- Understand the nature of existing and emerging disaster management models
- Explain limitations and strengths of different disaster management models
- Explain the need for comprehensive disaster risk management

Key Concepts

- Our understanding of hazards and disasters has changed markedly through history.
- The development of a comprehensive disaster management model requires the recognition of the issue of complexity that evolves from the management of activities and the characteristics of a complex environment.
- Emergency management approach is the traditional approach characterized by reactive, top-down, event-focused and gives emphasis on short-term activities to contain disaster events through emergency responses.
- Risk management approach is the current approach to disaster management focusing on proactive, process-oriented methods and emphasizes on long-term activities to reduce underlying vulnerability and enhance people’s capacity to resist, cope with, prepare for, and respond to the impacts of disasters.
The emergence of disaster risk as an organizing construct has significantly undergone changes regarding the understanding of disasters and hazards as well as the nature of responses to disasters. Keith and Petley (2009) assert that in the past disasters and catastrophic events were seen as “Acts of God” which sees damaging events as a divine punishment for moral misbehavior, rather than as a consequent of the interface between the social and the physical environment. In this view disasters are seen as external, inevitable events lying beyond the capacity of human beings. However, today that understanding has changed. There has been a convergence of thinking that has progressively integrated both the natural and social sciences and connects antecedent risk conditions with ‘realized’ risks.

In this conceptualization, disaster risk specifically refers to the probability of harmful consequences and outcomes (such as death, injury, property damage, disrupted lives and livelihoods of environmental damage) resulting from the interaction between natural and human-induced hazards and vulnerable socio-economic and environmental conditions. This conceptualization of disaster risk now offers a powerful vehicle for bridging the development and disaster domains, and its evolution is marked by several clear stages and paradigms. Regarding this evolutionary paradigm shifts Smith and Petley (2009) had identified the following four stages.

**Stage 1: The ‘natural hazards’ or the engineering paradigm**

The basic assumption here is that disasters are characteristics of natural hazards; they are perceived to be irrevocably caused by the impact of natural hazards on people and their activities. This sort of thinking lasted until around 1950. The paradigm had influenced the type of action that should been taken to address the problems of disaster in that period. The approach focuses on scientific weather forecasting and engineering solutions, where the latter
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implies the design of larger structures to protect human settlements from threats which were seen to be purely natural hazards.

Numerous criticisms of the natural hazards approach to interpretations of disasters were offered in the 1980s and 1990s. The following are some of the criticisms given by scholars in the field of disaster risk science.

I. Smith (1996) argued that the natural hazards approach is not robust enough to explain the nature of disaster risks due to the fact that biophysical processes are not sufficient conditions for understanding the complex dynamics of vulnerability as the key variable of the disaster risk.

II. Lambe (1994) noted that the approach neglected both structural factors and human agency both in producing vulnerability and coping/adapting to it. He emphasized the role of these factors in determining the nature of disaster risk associated to natural hazards.

III. Hewitt (1997) claimed that this approach over emphasized extreme events while neglecting the root causes and everyday social processes that influence vulnerability and the nature of disaster risk associated to extreme events.

Stage 2: Behavioral paradigm

This paradigm covers the period 1950-1970 and unlike its predecessor, this approach expanded to incorporate notions of human agency in the exacerbation of natural hazards’. In this view selection of unsafe settlement sites, deforestation and overgrazing etc are considered as major factors fueling disasters. The universal consequence of disaster was believed to be a temporary disruption of normal life. The behavioral perspective recognizes the role of human behavior and perception. The main aim was to contain the extremes of nature through environmental engineering works such as flood embankments and earthquake-proof building. On top of that priority was given to disaster plans and emergency response. Critics of this view consider it a materialistic and deterministic approach that reflects too much faith in technology. In addition it is blamed for exaggerating the role of individual choice in hazard related decisions.
neglecting environmental quality and for being slow to recognize the role of human vulnerability in disaster impacts.

**Stage 3: The developmental paradigm**

The ‘development paradigm’ of disaster had come about during the 1970s, largely as a result of work by social scientists with first-hand experiences in developing countries. Manyena (2006:439) acknowledges primarily Phil O ’Keefe, Ken Westgate and Ben Wisner (1976) for profiling the importance of vulnerability in disaster discourses in their paper, entitled ‘Taking the Naturalness out of Natural Disasters ’.

This approach placed the importance of human vulnerability as the key drive of disaster related loss in the forefront. It also profiled the plight of the urban and rural poor, especially those in developing countries, and showed that they face disproportionate loss and hardship. The critical role of social vulnerability as a key drive of risk and hardship was particularly championed by political ecologists such as Blakie et al. (1994), Wisne et al.(2004) and Pelling (2003) as well as in noteworthy contributions by Hewitt (1997). In other words, disaster is considered as a function of the characteristics and frequency of hazards experienced at a specified location, the nature of the elements at risk (people, infrastructure and economic activities) and their inherent degree of vulnerability or resilience to it.

**Stage 4: The complex paradigm:**

Critics argue that the original western oriented disaster and hazard perception failed to manage the prolonged ‘complex emergencies’ which are common in Africa and other less privileged areas of the world calling for another paradigm which can fit to the realities of these particular areas. The theory also incorporates the so called new ‘catastrophic’ threats which could have a profound global impact, like terrorism. This newly emerging paradigm tries to perceive hazards and disasters as two sides of the same coin where neither can be fully understood from the viewpoint of either physical science or social science alone. Rather this recent view re-emphasizes the mutual interactions between nature and society.
5.2 DISASTER MANAGEMENT APPROACHES

Given the above paradigm shift in understanding disasters and hazards, which have determined the nature of responses to disasters, there are generally two approaches to disaster management. These are emergency management and risk management approaches. Emergency management approach is the traditional approach characterized by reactive, top-down, event-focused and gives emphasis on short-term activities to contain disaster events through emergency responses. Whereas, risk management approach is the current approach to disaster management focused on proactive, process-oriented and gives emphasis on long-term activities to reduce underlying vulnerability and enhance people’s capacity to resist, cope with, prepare for, and respond to the impacts of disasters. In addition, understanding the basic concept of the disaster management cycle is important in explaining the nature of these approaches (emergency management vs risk management).

Box: 5.1 the concept of disaster management cycle

In present day practice of disaster management, the social action to cope with disasters could refer to any purposive undertakings before, during and after their occurrence. This is exemplified in the prevailing concept that regards disaster management as a cycle with different phases, from preparedness through response, from prevention, mitigation and readiness, through relief, recovery and rehabilitation. The significance of this concept is its ability to promote the holistic approach to disaster management as well as to demonstrate the relationship of disasters and development. It also marks the basic difference between different disaster management models in their attempt to bridge the gap between disaster management stages and phases.

This relationship has enabled disaster relief activities to adopt the development approach over the traditional ad hoc relief approach. Furthermore, the relationship between relief and development as a cycle reinforces the fact that disasters, however inevitable, could be managed through adequate planning and preparedness for response.
With reference to the disaster management cycle, programme and activities on prevention, mitigation and preparedness comprise the development portion, while relief and recovery comprise the humanitarian assistance portion with preparedness linking both types of efforts.

5.2.1 EMERGENCY MANAGEMENT APPROACH: REACTIVE RESPONSES TO DISASTERS

This approach, although inappropriate within the present thinking of disaster risk reduction/management, was widely used by many African countries as a reference in managing disasters. This approach, which focuses around a disaster event, is designed to improve the efficiency and coordination of activities before, during and after disaster takes place. It does not take into consideration “external” essential influencing factors that had lead or exacerbated the hazards and vulnerability of the community and finally the disaster itself. It does not address the big picture of the community’s worsening living situation where disaster was an outcome. Disaster management models which can be categorized under this reactive and event-focused approach include Disaster Management Continuum Model, Pre-during-post Disaster Model, and Contract-Expand Model.

Box: 5.2 why do we need a disaster management model

There are four main reasons why a disaster model can be useful. These are as follows as stated by Kelly (1998).

1. A model can simplify complex events by helping to distinguish between critical elements. Its usefulness is more significant when responding to disasters with severe time constraints.

2. Comparing actual conditions with a theoretical model can lead to a better understanding of the current situation and can thus facilitate the planning process and the comprehensive completion of disaster management plans.

3. The availability of a disaster management model is an essential element in quantifying disaster events.
4. A documented disaster management model helps establish a common base of understanding for all involved. It also allows for better integration of the relief and recovery efforts.

**Disaster Management Continuum Model**

This model is the traditional approach to disaster management and has regarded a number of phased sequences of action or a continuum. This can be represented as a cycle. This model focuses on the disaster event and emergency response. The underlying assumption is that disasters are inevitable, the sequence of events is cyclical and interventions fit into various phases. This model has been used to design interventions around different phases of the ‘disaster cycle’. The Continuum Model prescribes a sequential series of actions to gain control over disaster events. Although cyclical or closed-loop, when used in the field of management the model indicates integration of feedback and learning into the system. Common interpretations of the disaster management cycle focus more on activities immediately before and after the onset of the disaster event. The main shortcoming of this model is that it treats disaster as inevitable although it is true that if hazard and vulnerabilities are managed well, disaster situations can be avoided. The model is reflective of the traditional approach to disaster management and activities are planned around the disaster-triggering hazard. Allocation of human, material and technical resources is in emergency response, disaster preparedness and structural mitigation.

**Pre-during-post Disaster Model**

This is similar to the Continuum model in that it looks at disaster management interventions in terms of what can be done in phases. The intervention activities revolve around the hazard. However, unlike the Continuum Model, it assumes that there is a clear beginning and end to disasters, and that activities for preparedness, mitigation and recovery should fit to pre, while and post-disaster phases, respectively. In this model, the hazard event triggers relief efforts aimed at minimizing suffering of the affected population and recovery measures aimed at restoring the community to the pre-disaster condition. However, restoration of communities to
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pre-disaster conditions is often difficult due to the fact that subsequent emergencies further undermine health and livelihoods of communities, and increase resources required for emergency management that would rather invested in development efforts.

Agencies that adopted this model of disaster management often failed to address the underlying causes of emergencies. This is mainly because the model views the process of disaster management as distinct and separate processes based on the different phases of disasters. For example, in drought-triggered disasters, agencies have often started relief operations only by paying attention to cases of starvations and malnutrition and highlighted declaration of state of emergency. Immediately after rainfall resumed the relief operations tend to stop on the assumption that the disaster was over; yet time was required for local food production to resume and for market prices of crops to get stabilized.

Contract-Expand Model

In this model, disaster management is seen as a continuous process. This model assumes a series of activities (prevention, mitigation, response and recovery) that can be run parallel to each other rather than as a sequence. However, the relative weighting of each component ‘contracts’ or ‘expands’ depending on the relationship between the hazard and the vulnerability of the community. The basic assumptions of this model are:

- Disasters occur when a hazard exceeds a community’s capacity to manage it (i.e. when its vulnerability has increased).
- All components of disaster reduction can be carried out concurrently, but with different emphases.
- The relative weighting of the activities depends on the relationship between the hazard and the vulnerability of the community at-risk and the technical or operational mandate of the organizations involved.
Like the Continuum Model, the Contract and Expand Model also views disasters as inevitable events. It is also externally driven as development agencies determine how to scale-down different interventions on the basis of their own assessments. These assessments tend not to give due consideration to underlying causes of vulnerability, but mainly focus on establishing who is vulnerable and quantifying their number to determine the scale of interventions.

5.2.2 RISK MANAGEMENT APPROACH: PROACTIVE RESPONSES TO DISASTERS

Unlike the traditional disaster management approach, risk management approach takes a bigger role in addressing the overall development processes so as to identify the disaster risks that emerge as a result of all human activities. It emphasizes the issue of reducing disaster risks before they build up to become disasters (realized risk). This proactive approach to disaster management also involves an integrated emergency response in responding to disaster events. Disaster management models such as Crunch and Release Model, and Disaster Risk Reduction Framework can be categorized under this proactive and risk management approach to management of disaster.

The Crunch and Release Model

As discussed in chapter three, this model shows that vulnerability (pressure), which is rooted in socio-economic and political processes, has to be addressed (released) for effective disaster risk reduction. It shows that a disaster happens only if a hazard meets conditions which make people and non-human elements susceptible to negative impacts of the hazard.

In the Crunch Model, the elements at risk are assessed to establish the causes of their susceptibility to hazard impacts. The outcome of the assessment will give a picture of what pushes people to unsafe conditions that make them susceptible to a disaster. These ‘push factors’ are classified into ‘root causes’ and ‘dynamic pressure’ which would be released to make the vulnerable community resilient. The progression of vulnerability that pushes people into unsafe locations is used to explain disaster occurrence.
Dynamic pressure results from structures which are responsible for pushing the vulnerable groups into unsafe locations. Local landowners, commercial companies and local governments are examples of such structures. They impact on the poor through processes such as policies, practices and decision-making.

For structures and processes to create dynamic pressure, they need to be based on or influenced by underlying causes, such as political ideology, economic principles, and culture. These underlying causes influence the behaviour of those in positions of power, whose decisions and actions can create the pressure that push people to unsafe conditions.

The Crunch Model shows the relationship between hazards and a complex condition of vulnerabilities (in a situation of low capacity) in causing a disaster.

This Model shows the strategies for the reduction of vulnerabilities. The outcome will be ‘safe’ as opposed to ‘unsafe conditions’, ‘resilient or capable communities’ as opposed to ‘vulnerable communities’ and ‘sustainable livelihoods’ as opposed to ‘unsustainable livelihoods’.

**Disaster risk reduction framework**

Recently, initiatives that adopt the developmental approach with emphasis on disaster prevention and mitigation are referred to as disaster reduction initiatives. The emergence of disaster (risk) reduction as a concept that integrates development-oriented strategies and recent innovative approaches to disaster management such as vulnerability and risk reduction has presented a new perspective in disaster management and also opportunities to address the important areas of concern that have been less focused on. The concept has also been applied in policy development, usually in the context of sustainable development and long-term socio-economic development strategies.

DRR framework is defined as the systematic development and application of policies, strategies and practices to minimize vulnerabilities and disaster risks throughout a society, to avoid
(prevention) or to limit (mitigation and preparedness) adverse impact of hazards, within the broad context of sustainable development. (ISDR, 2004)

The disaster risk reduction framework, as described in the 2002 ISDR review document, is composed of:

1. Risk awareness and assessment including hazard analysis and vulnerability/capacity analysis.
2. Knowledge development including education, training, research and information.
3. Public commitment and institutional frameworks, including organisational policy, legislation and community action.
4. Application of measures including environmental management, land-use and urban planning, protection of critical facilities, application of science and technology, partnership and networking, and financial instruments.
5. Early warning systems including forecasting, dissemination of warnings, preparedness measures and reaction capacities.

5.3 COMPARATIVE ANALYSES OF DISASTER AND RISK MANAGEMENT MODELS

The comparative analysis of models, as illustrated in table 5.1, reveals the following limitations:

- The design of most of the models revolves around the four main phases of disaster management: prevention, mitigation, response and recovery.
- There is no single model that encapsulates most of the major activities of disaster management within a single framework.
- The above-mentioned models do not consider the dynamic conditions of the environment (e.g. Climate change) that might affect the severity of a disaster. They only think of environment as another disaster category.
- Some models fail to present a comprehensive description of disaster management activities within a single model. Furthermore, the arrangement of activities (if any) is not in a logical sequence.
The evaluation and analysis of information and data related to a current disaster are highly important and essential ingredients in the mitigation of future disasters. The existing models do not give effective consideration to evaluation and analysis.

The current models discussed above lack all of the required features and functionalities that would enable them to manage a disaster in a comprehensive manner. Hence, the need for a comprehensive disaster management model that can fill in the gap which occurs in the current models has been highlighted over recent years. In addition, the need for comprehensive disaster management model that enhances the ability to handle complex and difficult disaster scenarios as well as addressing dynamic nature of risks related to climate change which are not addressed by the current models is a critical issue in recent times.

However, the development of a comprehensive disaster management model requires the recognition of the issue of complexity that evolves from the management of activities and the characteristics of a complex environment. The characteristics which make disaster management a complex domain are as follows:

- A large number of activities involved with varying features and functionality
- Changing environmental conditions
- Highly interdisciplinary and its changing nature
- A global perspective
- Dynamic decision support needs
- Data scattered at various sources
- The complexity of the system
- Uncertainty involved in decision-making
- A huge volume of diverse data.
### Table 5.1: COMPARATIVE ANALYSIS OF DISASTER AND RISK MANAGEMENT MODELS

<table>
<thead>
<tr>
<th>Character</th>
<th>Continuum model</th>
<th>Pre-during-post model</th>
<th>Contract and Expand Model</th>
<th>Crunch and Release Model</th>
<th>DRR framework</th>
<th>DRR and CCA framework</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approach</td>
<td>Crisis/emergency management approach</td>
<td>Crisis/emergency management approach</td>
<td>Crisis/emergency management approach</td>
<td>Vulnerability reduction approach</td>
<td>Risk management approach (proactive)</td>
<td>Risk management approach (proactive)</td>
</tr>
<tr>
<td>The basic assumption about disaster and risk</td>
<td>Disaster is a natural process and there is no beginning and end of the event; Disaster will happen and there is a beginning and end of the event.</td>
<td>The extent of activities expand and stretch if there is crisis; Crisis event dictates the extent of disaster management activities</td>
<td>Disaster is a social construct. Disaster happens when vulnerable groups are pushed into unsafe conditions and capacity is insufficient to cope with the hazard event</td>
<td>Risk is a social construct. Risk is greater if the hazard and vulnerability is greater and capacity low. If there is a greater risk, most likely disaster will happen.</td>
<td>Risk is greater if the hazard and vulnerability is greater and adaptive capacity low;</td>
<td></td>
</tr>
<tr>
<td>The focus of DM activities</td>
<td>Disaster management activities before and after are identified. The activity is cyclical</td>
<td>Disaster management activities before and after are identified. The activity is very simplistic and linear</td>
<td>Disaster management activities are identified and done in a linear approach</td>
<td>Increasing the capacity to cope through reducing the vulnerability and hazard (social analysis-centered)</td>
<td>Risk management, eliminating or reducing vulnerability, understanding the hazard characteristics and building the capacity based on hazard and vulnerability (social and science analysis-centered)</td>
<td>Most concerned with the future – i.e. addressing uncertainty/new risks through climate risk mitigation and adaptation measures</td>
</tr>
<tr>
<td>Types of change</td>
<td>Functional change</td>
<td>Functional change</td>
<td>Functional change</td>
<td>Functional and structural change</td>
<td>Functional and structural change</td>
<td>Functional and structural change</td>
</tr>
<tr>
<td>Key actors</td>
<td>Disaster managers</td>
<td>Disaster managers</td>
<td>Disaster managers</td>
<td>People, social development workers and technical people</td>
<td>People, social development workers and technical people</td>
<td>People, social development workers and technical people</td>
</tr>
</tbody>
</table>
CHAPTER 6: DISASTER RISK MANAGEMENT PROCESS

General description:
This chapter introduces the process of disaster risk management and raises awareness about the basic interrelationship between components of the process of risk management as well as activities of disaster management. Such awareness is useful in understanding the complexity of disaster risk management processes.

Learning Objectives:
At the end of this chapter, the participants should be able to:

- Define & Describe components of risk management and disaster management
- Understand the process of disaster risk management
- Explain the concept of risk treatment
- Be aware of the complexity of disaster risk management process

Key Concepts

- The process of Disaster Risk Management is bringing together the goals of action in disaster management (actions related to prevention, mitigation, response and recovery) with the process, structures and rigours of risk management.
- Risk management must be an integral part of any development program or investment of resources which aims at sustainability.
- Establishing the disaster risk management context is the foundation for the comprehensive disaster risk management process.
- Risk treatment measures can be identified based on the information obtained from the process of risk assessment (risk identification, risk analysis, and risk evaluation)
6.1: INTRODUCTION

This chapter summarizes and comprehends the key issues, activities and processes discussed in the previous chapters. As we have discussed in chapter one (understanding disasters), the nature of disasters is rapidly changing and these changes are generally resulting from human actions and development patterns. The human and economic cost of disasters is rising, mainly because societies are becoming more vulnerable to hazards. The number of disasters is increasing, mainly because of climate change, urbanization and associated land degradation. Disasters triggered by natural hazards are a major threat to life and to sustainable development, especially in developing countries. The poor and weaker groups in society suffer most from disasters.

We have also discussed detailed aspects and components of disaster (hazard and vulnerability) and its different management approaches. Understanding disasters is therefore very complex because of the complexity of understanding the nature and characteristics of hazards that trigger it, and the challenges of understanding the complex and often deep-rooted Socio-economic vulnerability that determine the scale of its consequences. Generally, disasters are complex social occurrences which require significant effort by many different sectors and groups within society to manage the risks associated with them. They are very complex requiring action by a wide range of sectors across many jurisdictions.

As we have discussed in chapter five, due to the complexity of disaster management domain, there is no single model that encapsulates most of the major activities of disaster management within a single framework. Therefore, there is no doubt that taking a holistic approach is the only strategy to deal with the complexity. However what is needed is a process and framework to enable a holistic approach. This does not only include breadth of sectors and levels but also a range of activities that might be employed to deal with disasters. We want to mainstream disaster management. The process of Disaster Risk Management is bringing together the goals of action in disaster management (actions related to prevention, mitigation, response and recovery) with the process, structures and rigour of risk management.
To achieve sustainability at a community level, it is important to have a process for people to think how they can have better lives by protecting what they value and by managing the risks associated with development. In this regard, risk management provides a framework to enable people to think and discuss how they can deal with situations which may lead them not to meet their objectives. It is therefore an integral part of the development process. Despite the complexity and the highly variable context of each country, a very flexible approach to integrating and coordinating sectors and levels can be achieved through risk management.

**N:B:**

Activities of Disaster management + processes of risk management = A comprehensive disaster risk management process/framework.

- **Disaster management** is, often used in a general sense, covering the implementation of preparedness, mitigation, emergency response and relief and recovery measures. Therefore, a comprehensive disaster risk management process should include activities and processes of both disaster management and risk management.

- **Risk management** is the systematic approach and practice of managing uncertainty to minimize potential harm and loss. It comprises risk assessment (identification, analysis, & evaluation of risk) and the implementation of strategies and specific actions to control reduce and transfer risks.

The crucial idea is that risk management must be an integral part of any development program or investment of resources which aims at sustainability. For the purpose of this module, we adopted the Australian risk management process (see figure 6.1). They define risk management process as “the systematic application of management policies, procedures and practices to the tasks of establishing the context, identifying, analysing, evaluating, treating, monitoring and communicating risk”.
6.2: COMPONENTS OF DISASTER RISK MANAGEMENT PROCESS

In the disaster management context, the main elements of the disaster risk management process are the following:

**Step 1: Establishing the disaster risk management context**

This is the foundation for the process. This establishes the crucial relationships between stakeholders so it is a very important part of the process. This step outlines the broad boundaries or scope of the process and examines which range of risks would be considered to what objectives and who the key stakeholders are. This stage cannot be too prescriptive.
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because it must reflect needs and aspirations of the participants. Once the broad context has been set, it is necessary to decide and record the roles and responsibilities of the participants and the administrative structure. The level/scale of disaster risk associated to hazards should be defined in order to determine roles and responsibilities of disaster management. For example, a village or a nation may both identify flooding as a source of risk but the elements at risk at these levels would be different. A national government might be responsible for protecting major infrastructures whereas a village may have a very local focus. In addition, based on the scale of disaster risk associated to hazards, in this case, drought (identified as a source of risk at both national & village level), the resources available and the types of treatment strategies adopted vary across international, national, and local levels.

**Step 2: Identify the disaster risks.**

This step identifies what hazards could occur and what would be the consequences for a community/society under consideration. This is a very useful activity for all participants to contribute their knowledge and values. Local experience can be extremely valuable in avoiding costly mistakes.

**Step 3: Analyse the disaster risk.**

Once lists of risks have been generated, they have to have estimations of likelihood and consequence allocated to them. The analysis should consider how likely is an event to happen, and what are the potential consequences and their magnitude. The analysis results in an estimation of the level of risk.

**Step 4: Evaluate disaster risks.**

This step aims to rank risks in order of priority in order to make judgements about which ones are going to have resources allocated to them. Any group will be faced with a long list and choices have to be made about which risks are to be treated given limited resources.
N:B:
The process of risk assessment, as discussed in chapter four of this module, involves three interrelated processes (risk identification, risk analysis, and risk evaluation). Hence, the three elements mentioned in steps 1, 2, and 3 can be understood as the process of risk assessment.

Step 5: Treat the disaster risks.

There are four broad activities in this section. Identify and assess treatment options, prepare and implement treatment plans. If stakeholders are not committed by this stage very little will happen. It is also a great opportunity for communities to be very creative in coming up with local solutions to problems. It is very important that participants have access to the experiences of other communities going through the process. Risk treatment measures can be developed based on the information obtained from the process of risk assessment (risk identification, risk analysis, and risk evaluation). Risk treatment measures are commonly divided into ‘risk control’ and ‘risk finance’. Risk control is further broken down into ‘risk avoidance’ and ‘risk reduction,’ while ‘risk finance’ is composed of ‘risk transfer’ and ‘risk retention’. (See figure 7: classification of risk treatment tools).
These risk treatment measures can be applied to avoid, reduce, transfer or retain the risk. Given the conventional conceptualization of risk as \( \text{Risk} = (\text{Probability of Loss}) \times (\text{Loss}) \), figure 6.2 illustrated application of appropriate risk treatment measures based on the relationship between loss and probability of loss. In this regard, a case of low probability of loss with little loss would yield low risk, while a case of large loss with a high probability of loss would yield a high risk. Therefore, if a significant degree of loss with high probability is expected, risk avoidance should be selected as the best countermeasure. When a significant degree of loss with low probability is expected, risk transfer would be an appropriate measure. In the case of a low degree of loss without reference to probability, risk retention is one of the options to be selected. In several cases, risk treatment would not be possible through countermeasures.
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Risk reduction would therefore be the mainstay of these countermeasures. Figure 8 describes the concept of risk treatment.

![Concept of risk treatment](source: ADPC, 2005)

It should be noted that the total loss can be reduced by risk control measures, though remaining damage may be unevenly distributed among certain population. Affected people can be assisted by a number of non-affected people with risk finance (Risk Transfer and Risk Retention) in order to reduce recovery periods of affected communities. Since risk finance cannot reduce the physical damage, optimal assortment of risk treatments is significant for the efficient disaster risk management. In addition, it should be noted that risk reduction measures should be the mainstay of these countermeasures for the efficient disaster risk management. Risk reduction measures refers to the development and application of policies, procedures and capacities of the society and communities to lessen the negative impacts of a possible impact of
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natural hazards and related environmental and technological disasters. This includes structural and non structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse impact of hazards, as well as the development of coping capabilities.

**Step 6: Monitor and review.**

It is important to check to see if the process is on track and changes in the environment have been included. These changes may include building new infrastructure, introducing a new technology, new scientific information about a hazard etc. and ensure that the disaster risk management plan is relevant. The entire process is iterative.

**Step 7: Communicate and Consult.**

It is essential for ALL stakeholders to have an appropriate level of input to the process. If stakeholders develop ownership as they define problems, then they are much more likely to be committed to participating in the implementation of solutions.

**Reference:**

Asghar, S., Alahakoon, D., Churilov, L. A. Comprehensive Conceptual Model for Disaster Management. Clayton School of Information Technology, Monash University, Australia

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